THE

ELECTRICAL REVIEW.

VOL. LVI. MAY 12, 1905. No. 1,433.

ELECTRICAL REVIEW.

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THE

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"SCIENTIFIC" LITERATURE.

RECENTLY a number of the Chemical Society's "Transactions" has been issued to members which, besides its usual chemical contents, includes an account of the proceedings at the last annual general meeting of the society, when Dr. W. A. Tilden, F.R.S., was in the chair. On that occasion, before entering upon the physico-chemical portion of his address, the President devoted several words to what may be termed political matters which interest supporters of kindred "learned" bodies. First of all, however, he told us of two terrible crises through which the society had passed during the preceding twelvemonth. Certain restless spirits had expressed a desire that the word "radicle," so spelt in the *Journal* for many years, should thereinafter appear as "radical," arguing the question with all the skill and amplitude it deserved. Instead of referring the whole business to the pundits of the Philological Society, as it should have done, the Council sheltered itself behind the miserable plea that the word was moribund, and the editor was instructed to avoid its use in future. Other members, impressed by the important work now being done by numerous ladies, proposed that women should be made eligible for fellowship in the Society; but counsel reported such a step to be impossible under the existing charter. Then it was suggested that some complaisant lady should allow herself to be elected and admitted, for the purpose of investigating the phenomena that might ensue, even did they include a prosecution for arson in the third degree. Various circumstances conspired to prevent so reckless a step being taken; and now the idea is to have lady Associates, or to apply for a monœcious supplemental charter. One cannot help feeling that in both cases the inherently unscientific nature of Englishmen has once again been demonstrated, lovers of accuracy and research being sacrificed to the fetish of peace at any price. Dr. Tilden mentioned that when a certain matter which had been debated by the Council was laid before the ordinary members, the number of those who troubled to attend was smaller than that of the Council—and this brings us to the point we wish to discuss.

A "learned" society is either a qualifying body or a publishing body. In the first case, its duty is to hold examinations, or in other ways to arrange for the granting, withholding and withdrawing of certificates of professional and moral efficiency. In the second case, its duty is to publish a journal on joint-stock lines. The latter kind of society may also hold periodical conversazioni at which the younger members may introduce themselves to their seniors, and the older men gossip of "shop." Sometimes a useful discussion may arise, but its benefits are necessarily limited to such members as live near the place of meeting. Hence it is the paramount duty of a publishing society to issue the best journal possible, and, while not acting unkindly to those members who are authors, to remember the interests of the majority who read. To put an unpleasant matter bluntly, most learned society journals (we are by no means thinking of the Chemical Society alone) require to be managed and edited on very different lines from those that

obtain at present. It is quite possible that in certain directions there is a competition between such journals for the honour of first publishing the researches of distinguished investigators, whose prolix manuscripts no mere man would venture to "blue pencil," except under a well recognised system of universal application. On the other hand, it is always an honour for any investigator to have his researches printed in the journals which contain the classical studies of his predecessors. Under present conditions a man's work can seldom interest more than a part of the membership of the society that undertakes to print it free of cost, and courtesy to his fellows should prevent him from writing at such inordinate length that the bill is extravagant, and the publication of other papers unreasonably postponed. Dr. Tilden makes a mild appeal to authors on these lines, but such appeals have appeared before, and are always ignored. Stronger action is needed. It is a nuisance to find our bookshelves constantly getting filled up with journals almost too heavy to hold or to bind. Seriously, it is not just that so much money should be wasted on the printer and the paper-maker every year. But most seriously of all, it is an intolerable tax upon the little time we have to spare for the technical reading which cannot be omitted, that we should be compelled to crush such an enormous mass of ore before arriving at the precious metal. The art of abstraction has been developed to a high pitch of excellence. If authors cannot learn the trick of proportioning the number of their words to the importance of what they have to say, and if the publication committees of the journals issued by "learned" societies cannot devise some scheme for securing proper brevity, the "constant readers" of society journals will have to combine in insisting upon a modified system of abstraction being applied to all the original communications that need it.

Wanted: A New Specialist.

TO-DAY is the age of specialisation, and electrical engineering has fallen into line with other callings. It is impossible for any one man to cover intelligently the whole subject of electricity supply, and hence the need for specialisation and appeal to the authority of the consulting engineer has arisen. It is, however, a curious circumstance that, whereas the methods of generation and distribution have been parcelled out into special subjects, the actual object of the process—illumination of premises—is often left either to the decorator, the architect, the fittings manufacturer, or the non-technical owner of premises. The borough electrical engineer and his assistant sometimes offer well-meant advice, but, being more intimately connected with the heavier branches, they have not sufficiently studied the subject of illumination to be ranked as specialists. There is now a field for a specialised illuminating engineer whose consideration should be directed to such points as the following: The position, grouping, shading and reflecting of lights; the installation of circuits to obtain the maximum number of lamp-hours per equipment; the æsthetic arrangement of the lighting in public buildings, such as art galleries, theatres, and churches, and economies connected with the selection and renewal of incandescent and other types of lamps.

That such an engineer is required, can be seen by noting the defects in lighting found at present in public and private installations. Lamps are hung so as to be unavoidable by the eye, and are hence most irritating; at the other extreme we have lamps so densely shaded that the bulk of the light paid for is wasted. The grading of illumination is improperly carried out. The same candle-power per unit area is found in the library, the dining-room, and the billiard-room. Probably much of the opposition to the Wright demand system is due to the presence of the large excess of lamps over those continuously necessary, in installations equipped by persons unacquainted with the elementary principles of economical and effective illumination. The status of the illuminating engineer would be quite as high as, say, that of the authority on water-softening, and the benefit conferred both on the consumer and the supply authority by his hours would be immense.

The Breaking-up of Streets.

A POINT of some importance to gas and electric lighting companies was decided by Mr. Mead, one of the Metropolitan magistrates, on May 4th. It appeared that the Commercial Gas Co. had occasion to lay some new gas pipes in a certain street within the metropolitan borough of Poplar. The street in question comprised, as an integral part of its structure, a layer of concrete, part of which the company found it necessary to remove. The gas company were at liberty to either reinstate the street themselves, or else to allow the Borough Council to do the work and charge the cost to them. The company reinstated the street in the manner which they considered proper, but a subsidence took place which necessitated further work by the Borough Council. Physically, it was impossible to put all the earth back, and although the company had put in as much as they could, a subsidence took place in the road. The Council then decided that when a trench was dug it would be necessary for the company to put in thicker concrete, otherwise the road was not as good as before. The gas company refused to pay for the concrete on the ground that they were not responsible for extra improvements. It was argued on their behalf, and with some show of reason, that if they are bound to put in a deeper layer of concrete, they would in effect be under liability to bridge over the pipe, and to make the road much better than it was before. They contended that the statute laid them under no such obligation, and that their liability was restricted to restoring the road to as nearly as possible the same condition that it was in before, with the same materials. Mr. Mead, however, held that the company were bound to reinstate the street to the extent of making it as good as it was before, even though they incurred additional expense in so doing. He therefore imposed a fine upon the gas company, but consented to state a case for the opinion of the High Court. The importance of this case to electric lighting companies lies in the fact that they, too, are bound to reinstate any streets which they may have to open up. The case under notice is an authority for the proposition that an electric lighting company must make the road good at whatever cost. If a gas company or an electric lighting company (as the case may be) fails in the performance of this duty, they may be exposed to serious liabilities. Thus in a case tried in 1896 an action was brought against a gas company for injury caused to the plaintiff who was thrown out of a vehicle owing to the imperfect reinstatement of a road after laying a pipe. The defendant gas company contended that that they were only liable to the penalty imposed by the Gasworks Clauses Act, 1847, Sec. 10, which compelled them to reinstate without delay, and imposed a penalty if the work was not carried out within a certain time. Lord Russell of Killowen, however, held that the action would lie because there had been more than a mere breach of duty, the jury having found there was a nuisance committed.

"The Wreck of the Trades Disputes Bill!"

"WE congratulate the Conservative Party upon the success with which its agents have succeeded in wrecking the Trades Disputes Bill. The working men and working women of the United Kingdom will appreciate to the full this impudent refusal of the right of combination."

So says the *Daily News* of the 9th inst. As we reported a few weeks ago, the first clause of this Bill passed the Committee stage *without modification*, but because some members of Parliament, among them being employers of labour, hold somewhat different views to the apostles of Trade Unionism, the latter, merely because they cannot have it all their own way, prefer to see the Bill "wrecked" as they call it, and, on the strength of this, obtain a cheap partisan electioneering cry.

What are the facts of the case? The object of the Bill is to make picketing, or "peaceful picketing" as it is called, lawful. Mr. Galloway, a large employer of engineering labour, moved an amendment to the effect that if any worker complained that he was annoyed by the pickets, such

annoyance, if continued, would be unlawful. This amendment was carried, and it was this simple modification, which will be welcomed by all peacefully-inclined workmen, that so greatly upset the promoters of the Bill, and gave them a pretext upon which to attempt to withdraw the Bill, which, it was maintained, had now been reduced to an absurdity.

The withdrawal was successfully opposed, and on the discussion being resumed, an amendment proposed by Mr. Galloway was the signal for practically the whole of the Labour members and supporters of the Bill to leave the Committee room.

Clause 2 was then, on the motion of the Solicitor-General, deleted altogether, and after one or two amendments to Clause 3, the Bill was agreed to and reported to the House for third reading.

Before leaving the scene of action, Mr. Burns made an attack on the Solicitor-General, and upon Mr. Galloway, one of the members for Manchester, saying that the latter had "achieved a legislative distinction in massacring the innocents." Fancy Mr. Burns posing as one of the innocents! He then said it was useless to proceed with the Bill in face of the opposition of the Solicitor-General, who "could command battalions." Mr. Burns has a leaning towards good old Anglo-Saxon expressions, but perhaps the more modern word "piffle" most accurately summarises his remarks, for, as the Solicitor-General pointed out, so far from being able to "command battalions," every amendment he had proposed had been defeated.

The general attitude of the supporters of this Bill has been to show that the Trade Unionist agitators have not yet learnt the salutary lessons which the great strikes of recent years should have taught them; and the Committee were quite justified, as the Solicitor-General put it, in refusing to allow themselves to be compelled to pass legislation for the wilful obstruction of peaceful citizens.

As we have often mentioned before, we are in the heartiest sympathy with the original aims of Trade Unionism, but we have no patience whatever with the latter-day pretensions of Unionist leaders to arrogate to themselves the position of dictators on all questions affecting the conduct of labour and methods of works management.

Expert Advice for Small Plants.

A THOROUGHLY equipped engineer is often regarded as indispensable for important works but too great to be troubled with small and simple undertakings. We know of cases where small plants have been erected by rule of thumb, or slavish imitation of successful undertakings, and also of those where a consulting engineer, employed during the erection, has been abandoned when the plant has been brought into working condition. We suggest that it is precisely at this point that a consulting man is needed. It requires, perhaps, more detailed knowledge of engineering economics to make a small plant pay than one of a larger size, and it must be a very unimportant piece of work indeed that is not worth doing well. Such diminutive undertakings are often in charge of purely practical men, whose memory and wits have been sharpened by long and hard experience, but whose training has not included that drilling in first principles (dubbed by them "theoretical stuff") which would have given them that power to estimate general issues which makes for ultimate success.

Reliability, or even fair financial success, is not the final test of the soundness of engineering work. This must be gauged by the possibility of further economical improvements, and it is safe to say that the periodical visitation of a thoroughly well trained engineer, empowered to overhaul and, if necessary, renovate the plant, to inspect the books, collaborate with the staff, introduce new methods of operation, and gauge the possibilities of development of the scheme, would prove beneficial to the majority of small public and private installations at present working on an independent basis. These functions, as regards the running of the plant, are now being performed to a limited extent by the inspectors of some of our insurance companies, but only from the point of view of safety against fire or accident. A similar periodic inspection from the standpoint of general engineering fitness would be a most desirable development.

NOTES ON THE CONTROL OF MOTOR-HIRING DEPARTMENTS IN CONNECTION WITH ELECTRIC SUPPLY UNDERTAKINGS.

By R. C. WEST.

THE importance of the above department in connection with electric supply undertakings having now been fully recognised, a few notes on its management may prove of use to those who have started or intend to start a motor-hiring department. The value of a motor load and its attendant effect on the load factor is so self-evident, that it is not necessary to go into detail as to why power-consumers should be encouraged.

Electric driving being a comparatively new departure, power users are naturally chary of adopting it without a certain amount of persuasion in the majority of cases; they require convincing proofs as to its suitability, and more especially its cost as compared with other and more firmly established methods. This being the case, it will be seen that it is most necessary to have someone at the head of the department who is competent to extol the advantages of motor driving, and, if required, give advice to probable consumers with regard to approximate cost and certain technical detail with which the average user of power on a small scale is unacquainted. It will often be found advisable, where the probable customer already uses some other system of driving, to conduct tests with his present system and compare them for his edification with a similar test, using an electric motor as the source of power. Of course, this would only be resorted to in extreme cases, and where the future demand warranted the amount of trouble it would entail. These tests have, in the experience of the writer, invariably been found to furnish positive proof as to the suitability and economy of electric driving.

Having secured the customer, the next thing is to ascertain the type of motor which is most likely to suit his case, and the system of drive to be employed. As a rule it will be found that semi-enclosed moderate speed motors meet most requirements, and with regard to the drive, this is generally determined by the consumer, although occasionally it may be left to the discretion of the Motor Department. The speed of the motor will naturally to a certain extent be governed by the class of machinery to be driven. The question as to whether an open or enclosed motor is installed, will depend on the situation in which it is to be placed; owing to the vagaries of some of the insurance companies, the installation of a totally enclosed motor may be compulsory.

The fixing of the motor which is, as a rule, a comparatively simple job, can either be undertaken by the motor department or the customer. It will generally be found, however, that unless the consumer has suitable men in his own employ, he will prefer that this work be done by the motor department, and this, perhaps, is the most satisfactory plan. With regard to the wiring for the motor or motors as the case may be, the systems vary with different undertakings. Some go no further than their own meter and cut-outs, while others carry out the whole installation. Where the wiring is carried out by outside contractors, it will be found to give satisfaction if the contractor is furnished with a sketch showing the connections which it will be necessary for him to copy in order to comply with the regulations of the department.

If the fixing and wiring is done by the department, it can either be paid for outright, or, as is done in most places, a rental on it can be added to the annual rental of the motor. With reference to the installation, it should be seen that Board of Trade regulations with regard to higher voltages, such as the earthing of metal tubing which carries wires, and of the frame of the motor, are conformed with.

The motor being connected up and working satisfactorily, there only remains that it should be kept in good condition. This can be ensured only by a systematic and periodical examination, combined with a certain amount of attention on the part of the consumer. Before leaving the motor to his tender mercies, it is well to impress upon him the fact that although the motor *is* electric and *has* self-oiling bear-

ings, a little attention is still desirable. At the same time, it should be pointed out to him that in the event of anything serious happening to the motor, he must communicate at once with the hiring department, and not attempt to rectify matters himself. The writer has vivid recollections of one case in which, because a certain motor was sparking rather badly, the consumer poured oil over the commutator to cool it.

Regarding the renewal of brushes which are now, almost without exception, of carbon, the best plan is for a stock of brushes for each size of motor out on circuit to be kept at the electricity works or wherever the hiring department is situated, the department can then sell them as required to the consumer.

There is one other thing to be noted while at the installation end, *i.e.*, the handling of the motors being invariably in the hands of entirely inexperienced persons, it is well to issue with each motor a card bearing instructions for starting and stopping the same, and also as regards oiling. If this card or notice be hung, or, better still, nailed on the same board as the starting switch, it will be found to answer its purpose better than if it took the form of a pamphlet, as in the latter case it might get into the wrong hands, the person operating the motor never seeing it.

The staff of the motor department will, of course, depend largely on the number of motors hired out. It is often found advisable to combine the motor and meter departments, and make one assistant responsible for both. He should have under him in the motor department, motor fixers, inspectors and labourers, the number of each depending on the business done. The fixers need not necessarily be trained mechanics, but must be intelligent, handy men. The inspector should have a a good knowledge of motors, and be able to connect up, test for faults, and effect any minor repairs which may be necessary. It would be his duty to see that a periodical examination was made of each motor, and to report the result of that examination at the end of each day to the assistant in charge of the department. By this means a constant record of the condition of each motor is kept, and with suitable book-keeping the amount expended on it for repairs, &c., is easily arrived at. If the business is large enough to warrant it, it is advisable to always have in stock spare parts for each size of motor such as bearings, field coils, brush-holders, and even armatures, as by so doing the minimum amount of inconvenience will be caused to consumers through breakdown. Regarding the latter, there should be an agreement between the consumer and the authority, that if the breakdown is due to gross negligence on the part of the consumer or through fire, he (the consumer) shall pay the cost of repairs. While on the question of spares, it would be well to note that in order to keep these within bounds, one make of motor should be adhered to as far as is compatible with successful and economical working. It will readily be seen that by so doing, the number of spares required to be kept is less than if numerous makers of motors were hired out. There being now so many reliable makes of motor on the market, this should not be a difficult matter.

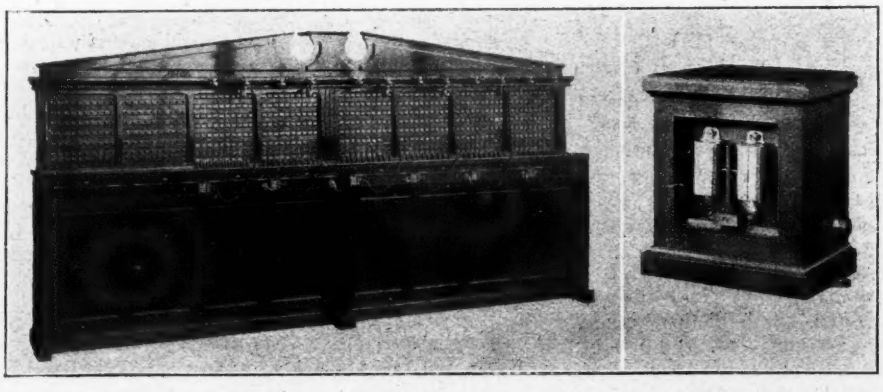
The bulk of the book-keeping of the department, such as relates to the purchase of the motors, hire, &c., would devolve on the clerical staff attached to the undertaking, and only such books as relate to the examination and upkeep of the motor itself would be kept by the motor department. These should be as simple, and at the same time, as complete as possible. The motor fixers should hand in particulars as regards the time spent on each job, together with the amount of material used, &c. This should be handed into the general office, after having been passed by the assistant in charge of the motor department, and then entered into the motor rental book, and if necessary a certain proportion of it added to the rental of the motor, if the consumer did not wish to pay for the fixing outright. The motor inspectors should be supplied with special forms or books, on which to enter the names and addresses of the consumers whose motors had been examined, together with a detailed description of the condition of various parts such as commutator brushes, bearings, &c., and also the repairs, if any, which have been executed by him. These forms or books would be handed in to the assistant in charge of the department, who would then be able to see the condition of each motor, the repairs done, and those which were necessary. With this system it is possible to keep in touch with each motor hired out, and small defects which might develop into more serious faults are sooner or later detected and rectified.

In conclusion, the writer has always found it advisable to keep in stock one or two of each size of motor, up to, say, 15 H.P., thereby being able to cope with urgent demands for power in cases where possibly the original source of motive power has broken down. Prompt attention to cases of this sort is an excellent advertisement for the electric motor, and more often than not results in the addition of a profitable consumer to the books of the undertaking.

THE MANUFACTURE OF TELEPHONES.

Considerations with which our readers will be familiar were, presumably, at the root of an invitation which we recently received to visit the Peel Works, Salford, of the General Electric Co., Ltd., and see for ourselves that the company really does make telephones. So forcible a demonstration of the fact was, perhaps, somewhat superfluous; but, at any rate, we are now able to state on our own authority that the company does not merely make telephones—it *manufactures* them.

In proof of this, the following statistics are of interest; the figures represent the average annual output during the past three years:—



G.E.C. 500-Line Hotel Switchboard. New Polarised Sounder for the B.P.O.

Telephone apparatus ...	32,500	Telegraphic apparatus...	11,250
Electric bells	91,000	Telephone annunciators	
Electrical indicators ...	17,800	and small switchboards	510
Switches	15,000	Large switchboards ...	115

Large as these figures are, the present year promises to show a much greater turnover than the average given above, as larger quantities than ever are now being manufactured.

The total number of hands employed in Peel Works is 1,750, of whom about 1,100 are employed exclusively on telephone and telegraph work.

Telephones and accessories are made for all classes of work—viz., for domestic use, hotels, offices, warehouses, works, collieries, tramways, railways, and for telephone exchange working, including the P.O. London system. The last-named apparatus represents the highest class of telephone work, and a considerable quantity of this apparatus is going through the works at the present time, in addition to instruments for the British Postal Telegraphs.

Large numbers of telephone switchboards are turned out, both of stock designs and of special designs to suit special conditions. The

largest switchboard hitherto made in one section is for 1,000 lines. The majority of the boards turned out range from 10 lines to 250 lines.

The most interesting features in telephone work, from a manufacturing point of view, are the varied number of materials employed, the large number of separate parts which have to be handled, and the large number of manufacturing processes on those parts. The materials regularly employed in telephone manufacture include every ordinary kind of hard-wood timber, iron, steel, copper, silver, platinum, zinc, brass, aluminium, phosphor bronze, German silver, gun-metal, bell-metal, nickel and tin; and each of these metals and alloys is primarily manufactured in every conceivable form, according to the manufacturing process to which it is to be subjected.

The insulating materials employed include ebonite, vulcanised fibre, bone, horn, ivory, silk, cotton, india-rubber, gutta-percha, porcelain, millboard, mica and paraffin-wax. Carbon is, of course, extensively used in various shapes and forms in the construction of transmitters and lightning arresters.

Even in a comparatively simple instrument such as the new pattern K 25 set which was shown to the visitors, there are no fewer than 173 distinct parts. Each part undergoes several processes in manufacture, the total number of processes on one set being 635 and the number of these instruments being manufactured at the present time is 5,000, thus making over 3,175,000 processes to one shop order.

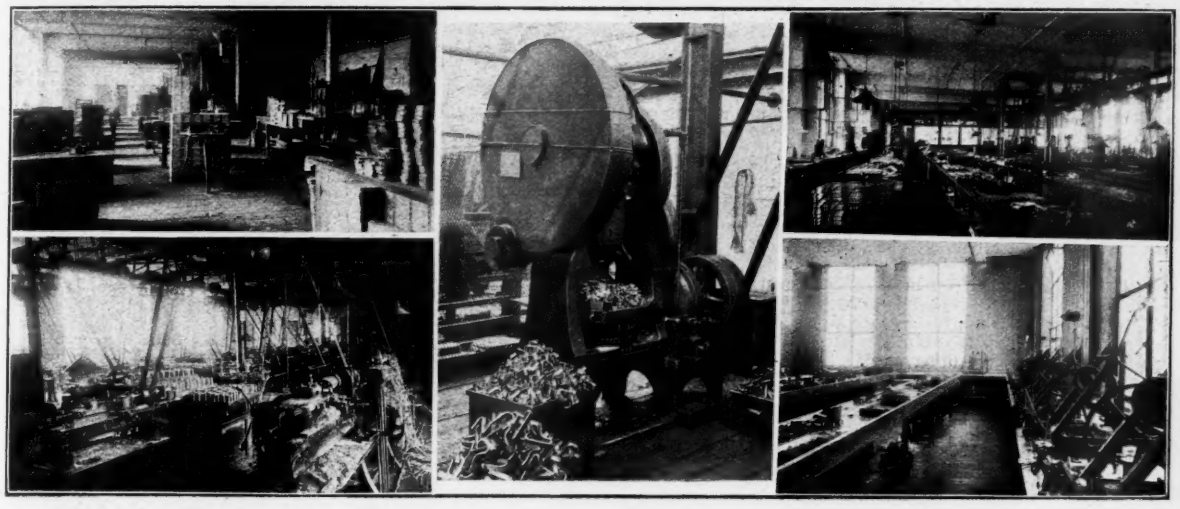
Further, patterns are constantly changing, and the average number of new patterns of telephones and accessories turned out all the year round is four per week.

Owing to the complexity of the operations in a telephone factory turning out a large number of different patterns, there is great difficulty in tracing every process on every part of every telephone from point to point until each part is incorporated in the finished instrument, and in ensuring that no single process shall be missed or incorrectly performed. A perfect system of organisation is, therefore, absolutely essential. In Peel Works the drawing is made the basis and the key of the whole position; the system adopted was explained to the visitors in detail, and it was clearly shown why it was thought necessary to provide such elaborate drawings in every instance. The parts required for any order are assembled in a special room in the stores, and in this room a record is kept, and posted up from moment to moment, showing the exact position of every part required for that order. No instrument, however small, leaves the works without being subjected to two tests—first, by the foreman under whose charge the instrument is fitted up; and, secondly, by an entirely independent test department.

In the coil-winding section, the number of coils turned out weekly averages 10,000. All of these are tested for insulation and resistance several times before they finally leave the section, besides being finally tested in the complete instrument. In the cord-making and braiding section, every telephone cord fitted on the G.E.C. instruments is made from the raw material.

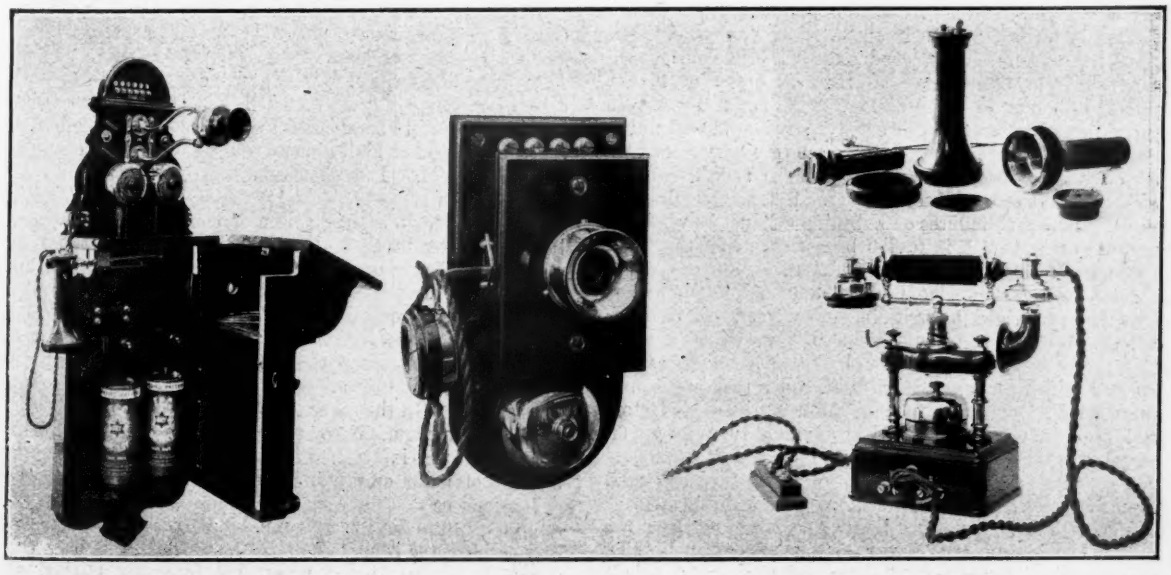
The whole of the tools required for the power presses, hand presses, drop stamps, turret lathes, and automatic screw-making machines, are made in the works tool shop, as well as all the special tools required for the wood-working machinery. In addition to this, the tool shop maintains the whole of the works plant.

A glance at a telephone instrument will indicate that a large number of screws are required for each instrument. For example, in the K25 set, a comparatively simple one, 110 screws are required, so that more than half a million screws are required for one order of 5,000 of these instruments.



Cabinet Shop. Brass-Finishing Department. | Power Press, shaping Magnets for Table Set. | Fitting Shop. Coil-Winding Shop.

VIEWS IN THE G.E. CO.'S PEEL WORKS, SALFORD.



P.O. standard C.B.S. Wall Set, as arranged for common battery signalling and local battery speaking. | New Pattern, K 25 set, specially designed to meet competition. | P.O. New Standard Bell Receiver for C.B. working. P.O. C.B.S. Table Set, with Magneto Bell.

SOME OF THE PATTERNS MANUFACTURED AT PEEL WORKS.

The whole of the screws used in the telephones (with the exception of wood screws) are made in the works, the total number turned out being many millions annually.

The G.E.C. first started manufacturing telephones in 1888, and have extended the work year by year since then. It has now been decided to use the whole of Peel Works as a telephone and telegraph factory, as soon as new works can be built for the other work now being done there.

Besides the Peel Works, the central stores of the company were visited. Here a stock of every pattern of telephone, bell, &c., made by the company is kept, a certain minimum number being specified, below which the stock must not be allowed to fall. Each branch establishment of the company also keeps a minimum stock, and draws upon the main stores to replenish it, while the storekeeper, in turn, orders specified quantities from the works whenever his stock approaches the lower limit. Thus the output is automatically regulated, while it is possible at any moment to see exactly how matters stand by means of the card system, which is extensively used in these works.

Special interest is attached to the fact that the British Post Office specifications state that preference will be given to apparatus of British manufacture. Without such aid it is hardly possible to establish so intricate a process as the manufacture of telephone apparatus in this country, though, when once established, it is evidently able to hold its own against competition under existing fiscal conditions. We have often pointed out that municipal and other authorities have driven trade abroad by wages clauses which do not apply to foreign firms; the least they can do, when thus handicapping the home manufacturer, is to give his wares the preference, other things being equal.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Are Lightning Conductors a Source of Danger?

The writer of the above article in your issue of 28th ult. has, I am afraid, been taking the publications of the Lightning Research Committee too seriously. His inference appears to be that, as a large proportion of the cases that this Committee had under consideration were said to have been provided with lightning conductors, lightning must be more prone to attack protected than unprotected buildings. But, whereas in the first year of its existence the Committee received reports of about one-sixth of the cases that actually occurred, in the succeeding years it only received a very small proportion because it intimated that it only desired reports of cases where buildings fitted with conductors had been damaged.

It would be absurd even to hazard a guess as to the number of cloud to earth discharges that occur every year during thunderstorms in this country; it is sufficient to say that the number is enormous, and since very lofty structures are obviously somewhat more liable to be struck than low ones, and most of the loftiest ones are fitted with conductors, a great number of failures of lightning conductors would be recorded every year if, instead of being safeguards, they were a source of added danger, or even useless.

Now, to my knowledge, between 300 and 400 buildings have been damaged by lightning every year, and of these less than a dozen had conductors. I have found most to have been fitted by plumbers, builders, ironmongers and kindred trades, the proportion fitted under the direction of experts being remarkably small. Most of these conductors had been in existence for periods ranging from 20 to 60 years, and had never been inspected or tested by experts during that period. The merest tyro in the subject would, in nearly every case, have condemned them as inefficient.

The lists so far published by the Committee confirm the figures I have given, which are based on a close investigation of the subject for the past 17 years, and these lists include one case that did not occur, some incorrectly described as fitted with lightning conductors, and a large number that could not be described as "protected" buildings from the point of view of modern knowledge of the subject.

The number of cases of failures of electric bells is, in proportion to the number in use, infinitely greater than that of lightning conductor failures. Would it be fair to say electric bells are, therefore, useless?

The case of the country house referred to in this article would probably have been differently commented upon had the whole facts been placed before the writer. That the house should have been in existence for 30 years without being damaged by lightning, and then be damaged twice within a few months of its being fitted with a number of lightning conductors, certainly looks a remarkable fact, but the owner informed me that when he built the house he had one conductor fitted to it; that at first thunderstorms never passed that way, but took another course; and that of recent years the tendency had been for storms to pass, more and more frequently, over his property. It was this fact, and the frequency with which trees and buildings on his estate had been struck by lightning in recent years, that caused him to have the one conductor replaced by a system embracing all the highest parts of the mansion. That damage occurred notwithstanding this extension was due principally to the fact that one very short rod was placed on each of some long chimney stacks, and that these rods were placed on what, I should have thought, any expert should have known was the wrong end of the stack.

It is difficult to explain the second case referred to, because I have not seen the Pyramids, and have only read the very meagre reports of the occurrence that have so far appeared in the Press, but it appears probable either that the upper part of the conductor had worked loose and fallen over (a not uncommon defect), so leaving the upper part of the masonry exposed to damage, or that to repair defects in the masonry metal cramps had been built in near to the conductor and not connected to it.

I cannot see what argument could be urged in support of the idea that a lightning conductor placed even on such a structure as this Pyramid should increase the liability to damage, while in the case of an ordinary building, considering that a lightning conductor is only a line of metal, and that most buildings already possess a number of conducting lines in the form of gas and water pipes, rain pipes and gutters, and in some cases even earthed electric light leads, how can the addition of, say, a copper tape 1 in. × ⅛ in. increase the liability to cause a disruptive discharge from a cloud more than, say, a 4-in. hydrant pipe carried to the top of the building as a precaution against fire?

Alfred Hands.

London, E.C., *May 5th*, 1905.

Shunt-Wound Motor Connections.

With reference to the diagram of connections by "Safe-Guard," in your issue of May 5th, may I be permitted to make the following remarks.

As is well known, highly inductive circuits, such as field coils of motors, are usually broken in such a manner that there is a path in parallel with the shunt to take up the shunt discharge, or high induced voltage, caused on opening the circuit. This, I may mention, is the usual procedure in metallic motor starters.

Reverting again to the diagram of connections all appears in order, if, on breaking the circuit by means of the D.P. switch, the dipper or blade of the liquid starter is left in circuit for a few seconds, thereby leaving a path in parallel with the shunt circuit to take up the shunt discharge. The dipper should then be raised ready for again starting the motor. It is important that the attendant should always see that the dipper is out of the liquid before closing his D.P. switch. On the other hand, the D.P. switch, which is fitted with maximum current and no voltage release, may be so arranged that its shunt coil may form a closed circuit for the field of motor on opening the circuit.

It would be well for your correspondent to satisfy himself as to the connections of this D.P. switch, otherwise damage may occur to the insulation of the motor field coils from the cause already mentioned, unless the foregoing method of operating the switchgear be employed in disconnecting the motor from the mains.

C. W. Denny.

London, S.E., *May 6th*, 1905.

The connections shown by "Safe-Guard" in your last issue would in all probability lead to a breakdown of the insulation of the field coils should the controller be pulled off and the D.P. switch opened later. In using the connec-

tions shown in his sketch, either a non-inductive resistance should be placed across the D.P., through which the shunt could discharge when D.P. is opened, or a resistance or bank of lamps can be so arranged that the controller in coming to the "off" position will place it in series with the shunt through the armature of the motor.

Motorman.

Boiler Rating.

While so much is being argued about boilers, attention may not inappropriately be drawn to page 694, April 28th *ante*, where a boiler of 3,580 sq. ft. is described as evaporating 14,000 lb. of water per hour. This is nearly 4 lb. per sq. ft., and it quite upsets previous ideas as to the rating of steam boilers of the water-tube type. It is, indeed, stated that the promoters of a certain power Bill were able to secure boiler prices 30 per cent. below the prices at which the same boilers had been sold to the intended victims of the new company. Is it possible that the 30 per cent. lower price was made on boilers whose rating was as 4 to 3, or 25 per cent. different? If so, the cheap price quoted in the committee room may not have been so cheap after all, and the cheapness of power stations may after all be merely a matter of high rating of plant. Anyone can at once halve the cost per KW. if only he will assume a double capacity. Now it is usual, I believe, to rate ordinary W.T. boilers at 3 lb. Why do we find them rated as per page 694?

Calories II.

[The data in question were obtained on the spot from the engineers, to whom we must refer our correspondent. But who are the "intended victims of the new company"?—EDS. E.R.]

Patent Agreements.

Possibly your readers will recognize a printers' error in the word "prebears;" at the same time I admit that my writing of the word "forebears" accounts for the error.

I might add, however, that I was surprised to find that "forebears" does not appear in several dictionaries. Murray gives it with various spellings and meanings, amongst others, "progenitors."

Reader.

[We were certainly puzzled by the word, and referred to the original letter for light when going to press; but we concluded that it was one of "Reader's" little jokes. "Forebears" ought to be found in any good dictionary; but how many, we wonder, are aware that the word is pronounced as "forbeers"?—EDS. E.R.]

A.C. v. D.C., and Other Matters.

The recent correspondence in your columns as to the respective merits of A.C. and D.C. engineers has, if it has done nothing else, at least given both sides an opportunity of explaining their own opinions of themselves.

The strange thing, to my mind, about both the A.C. and D.C. men is—that they appear to think that the only electrical engineers of any consequence are to be found in the municipal and other power stations.

We have heard much in this discussion of the art and skill exercised in the paralleling of continuous and alternating dynamos, and the high degree of scientific knowledge required to restrain the "howling alternators," &c., as if all the shining lights of the profession were engaged exclusively in that department.

But I venture to submit that there is another class of men who should be reckoned as electrical engineers, and who, in my humble opinion, are often more expert in the business than many of the young gentlemen who, having sauntered through the prescribed course of training, eventually secure "soft jobs" and good salaries, and consider themselves and their class as the only genuine electrical engineers.

I refer to the men who have charge of the power plants in our large industrial concerns. These men have in many cases had equal education, but instead of taking up central station work have remained, say, in the constructional branch.

After a few years of building central stations (both A.C. and D.C. possibly), they have eventually settled down to taking charge of the power plant, say, in a shipyard, engineering works or similar concern.

The knowledge of engineering (both electrical and mechanical) which the operating of a large works plant, with its complicated network of distributing cables and wiring, its numbers of motors, pumps, cranes, and all the machinery used in the works requires, and the expert handling of which is expected from the engineer, will on comparison be seen to at least equal that necessary for a central station.

A large works plant of modern design, contains all and more than the complications of a lighting and traction station, and works under more exacting conditions. It requires for its successful administration a man whose training must be as good, whose experience will have been more varied and extensive, whose daily worries and responsibilities are more wearing; and where general capacity should entitle him to at least as much consideration as the gentleman shift engineer, who will one day blossom out as the electrical engineer to the (truly) Rural District Council of Mudborough.

When the question of who are the best electrical engineers is discussed, I think it is only fair that the works engineer should put in some claim.

I submit that the best electrical engineer is not the A.C. man or the D.C. three-wire man, but the man who is in some way engaged in the active development of the field of work for electricity, and who either in constructing or operating is constantly handling or devising improvements—not the central station man, who is often and naturally as much "in a groove" as his own tramcars.

Ralph W. Birkett.

Stockport, *May 8th*, 1905.

In answer to Mr. Talboys Wheeler's second letter, as regards the "strong protest," the truth is often bitter, and a person who sets himself up as a superior being is an abomination unto his D.C. brethren!

I repeat that "once upon a time shift engineers at Tunbridge Wells only received from £50 to £52 a year." Whether they were "taking any responsibility" or not I cannot say—the unfortunate individuals were not taking much money, anyhow.

I am sorry that I have been treading on the toe of Mr. A. B. H. Cope, but I cannot see that letter has bettered the prospects of the Worcester assistants.

A. J. Abraham.

Cambuslang, *May 5th*, 1905.

I have no desire to be implicated in this controversy, but I feel obliged to retort to "Old Reader's" letter in your last issue. He speaks of shift engineers as inflated switchboard attendants, the very position every shift engineer should have occupied at some time in his run up the ladder. Perhaps "Old Reader" is not aware that an electrical engineer in the true sense of the term implies so many years at an engineering works—say five, three years as a pupil in an electrical station; three years as switchboard attendant and junior assistant—and I maintain that if a chap is any good he is able to take charge of any plant after being a junior shift engineer for a year, on top of the above qualifications. After being in a moderate-size station or stations for four or five years, he should be able to get an appointment as station superintendent, chief assistant, and, lastly, chief. It is true some of the above positions may be skipped—*i.e.*, charge engineer to chief assistant, or station superintendent to chief; and it is to the skipping of these positions that we owe trouble.

"Old Reader" states what is, unfortunately, a fact, that there are fitters who have been in a "marine works" for 25 years, and who, if you ask them, know all about dynamos and electricity works, who get a "job" when a new station is being built, as "pipework foreman," and the like. The result is, they are placed on the staff when the station is running, simply because there is no one else to run the engines at the time of opening the works.

This growing evil cannot be too strongly emphasised. In one case a mechanical man was put in charge of a station where one of the feeders shorted one evening during a heavy load, the "electrical engineer" shut down the whole of the plant and waited, what for, I do not know. One of the switchboard attendants meekly asked him if he could burn the fault out or switch off the affected feeder, but the "engineer" would not hear of it; just then the chief came in and ordered the sets to be run up, and in less than two minutes the fault was burnt out. The above is a true case.

Fitters are all right in their sphere, and electrical engineers could not do without them, but when it comes to a fitter being made charge engineer, or being placed over the charge engineer, then it is time, I say, that he was "chucked out of it." The majority of charge engineers are gentlemen, and their positions should only be filled by such. I must thank Mr. Editor for allowing a shift to speak his mind.

J. T.

Having read and digested the letters on the subject of A.C. and D.C. men, I feel disposed to defend Mr. W. T. Wheeler. He may be open to criticism, but should not be to insults. Mr. A. J. Abraham's letter is unkind and unjust.

Any man that has the brains to grasp A.C. work and to handle it in a thoroughly competent manner, should he be given charge of D.C. work, would, in my opinion, solve any problem that turned up. Should the D.C. man be given A.C. work, he would find the greater difficulty.

Re vacancy advertisement, if the post is D.C. work only, the smart D.C. man is preferable to the A.C. man; should the post be mixed A.C. and D.C., the A.C. man would be preferable.

I think those that are blessed with the faculty to use the pen should write something more beneficial to us readers.

Henry J. Webb.

Wednesbury, Staffs., *May 7th*, 1905.

It seems rather a pity that a discussion (although in this case not, perhaps, of such an educational value as usual) should be allowed to drift into personal attacks between parties. I take it that the main object of your "Correspondence" columns is for the discussion of matters of general interest; and, surely, it cannot be of general interest to read of quarrels between station and station, although it may be amusing to a few interested parties.

My opinion of the question under discussion is that any man who has had both D.C. and A.C. experience will have not the slightest hesitation in coming to the conclusion that a man who is properly qualified to take charge of a well-managed D.C. plant is of necessity a better man, especially from a technical electrical point of view, than the man in an A.C. station of same size, the main design of which is usually for simplicity, which can hardly be said of most D.C. plants.

With regard to the remarks of "Old Reader" (possibly a would-be shift engineer), I would venture to point out that whilst admitting that some stations, mostly municipal, have works superintendents or foremen fitters, who stand before the much-abused "shift engineer" in the matter of salary, it is the latter who has to take the responsibility of running the plant, and, in the event of breakdown, possibly caused by the carelessness or inexperience of the said works superintendent or foreman fitter, of getting the plant in working order again, in most cases before the much-lauded works superintendent or foreman fitter is aware of anything being wrong.

It must be borne in mind that there are black sheep in every branch of the electrical profession, but that is no reason for tarring every member with the same brush.

J. R. S. B.

"A.C. *v.* D.C." and the "Cult of the Marine Engineer" have been the source of a certain amount of amusement amongst station and charge engineers and switchboard attendants.

It would be as well to enlighten "Old Reader" that the term "shift engineer" does not mean an engineer so-called or otherwise who *shifts* from one station to another and visits a large number of stations, but a man who takes charge of a station during a set number of hours each day.

A charge engineer and also a switchboard attendant (I do not mean volt boy, for a man has no right to be in charge of a switchboard controlling the whole of a town's supply, unless he thoroughly understands the running of the station and knows how to act in cases of emergency and to take the place of the charge engineer if required to do so) should both be men with a thorough knowledge of the distribution and generation of electrical energy for power and lighting purposes, both alternating and direct; with the plant available they should know how to economically convert the coal or whatever it may be into electrical B. of T. units, be able to use a hammer and chisel and to superintend and assist, if necessary, any repairs or tests that are made in connection with the plant.

It is possible for part of this knowledge to be gained when following the marine engineering profession. The making of a charge engineer depends upon the man—not so much the particular place where his experience has been gained. The distinction between an alternating and direct current man is that the former is more familiar and up to the tricks of an alternating current system, while the latter knows what to expect from a direct current system.

R. G. B.

[We have been obliged to abbreviate some of the letters on this subject. Why is it that, sooner or later, correspondents wander away from the subject under discussion, and embark upon irrelevant personalities and recriminations of no interest to any but themselves? We like to let our correspondents manage our "Correspondence" columns as far as possible, but a certain amount of supervision is indispensable.

The correspondence on this question is now closed.—Eds. E.R.]

New Regulations for Electricity in Mines.

Special Rule 7, in Sec. 1, in the "Special Rules for the Installation and Use of Electricity in Coal Mines," reads as follows:—

"In every completely insulated circuit, earth or fault detectors shall be kept connected up in every generating and transforming station, to show immediately any defect in the insulation of the system. The readings of these instruments shall be recorded daily in a book kept at the generating or transforming or switch-house."

Will any of your readers be kind enough to describe a suitable arrangement to meet this rule where the voltage is 110 volts and the output of the shunt dynamo is about 50 to 70 amperes, showing the detector, instruments for taking the readings, and their connection to the terminals of the dynamo and earth?

Idris.

We notice in your current issue a letter from Mr. A. F. Harris, in which he suggests that instrument makers are unable to supply instruments to comply with the new mining regulations as to leakage detection. We should like to be permitted to reassure him on this point; as, however, we do not desire to make use of your "Correspondence" columns for advertising purposes, we beg to refer him, and any others amongst your readers who may be interested in the matter, to your advertisement pages. We may add that we shall be happy to furnish Messrs. Nalder Bros. and Thompson with the necessary information on the subject in order to enable them to satisfy their clients, who, doubtless, are clamouring for details.

Everett, Edgcumbe & Co.

87, Victoria Street, Westminster,
May 8th, 1905.

[Rudder Motors.—A correspondent wants to know the name of the present makers of rudder motors, with propeller and batteries, for fitting to small boats and punts.—Eds. E.R.]

Tests on Stirling Boilers at Neepsend Works.

Is Mr. Fedden wise to take so high a stand in regard to the anonymity of "Calories?" This is not a case of personality, but of physical quantities. Mr. Fedden says, $x + y = z$.

In the opinion of "Calories," with whom I agree, this is the equivalent for saying $6 + 2 = 10$. Now, on the facts, there can be no possible question of such a paltry matter as a man's name. The usual calorific value of carbon is 14,500 B.TH.U. Its maximum value by Berthelot's figures is only 14,647. Again, why ask for the name of "Calories" when Mr. Fedden himself has stated how much of the coal is not carbon or hydrogen, or sulphur or nitrogen? If Mr. Fedden still wants to stick to his damaged guns, let him try to make us believe that Shireoaks coal is abnormally sulphurous or nitrogenous.

D. M.

I am surprised to learn from Mr. Fedden's letter of 5th inst. that he has thought it best to consign to the waste paper basket, as unread, the ELECTRICAL REVIEW of 28th ult., or the portion of it containing my letter commenting upon the high efficiency he claims, as this result does not appear to be consistent with the other particulars he published—due to the letter being anonymous.

He seems to have given your correspondent of March 31st, who was somewhat more anonymous, a certain amount of countenance; as to who the latter is, I may say, in passing, I have not the slightest knowledge.

Judging by the number of anonymous letters generally, or even if we take last week's paper, having 8 out of 14 anonymous correspondents, it would seem that if this is the correct way to treat such letters, many of your papers will have an ignominious end.

It does not seem to me that it is correct to consider such letters anonymous in the same sense as those addressed to a man privately, as there may be conditions and circumstances which make it advisable to adopt a *nom de plume* in the case of published letters.

The facts remain the same, whether they are by an anonymous writer or otherwise, and do not concern the writers thereof only, but your readers generally; and in their hands I am quite prepared to leave the matter and allow them to draw their own conclusions.

Calories.

Electric Light and Calico Prints.

With reference to the letter written by "Calico Print" in your last issue, we would point out that we put on the market about three years ago an arc lamp specially designed for colour-matching, the invention of Messrs. Gardner and Dufton, of Bradford.

The arc is enclosed in a lantern fitted with special glass, transmitting only those rays which produce the same effect on colours as the light from a bright north sky; the result is an artificial daylight of constant quality and intensity which is probably more useful for appraising colours than daylight itself, which necessarily varies from hour to hour, and with every change of temperature.

The lamp has been adopted by most of the principal dyers, calico printers and paper makers throughout the country with entire success.

We believe this is the only invention for colour-matching by means of artificial light.

Drake & Gorham, Ltd.,
R. W. S.

London, S.W., *May 9th*, 1905.

Commutation in a Four-Pole Motor.

Mr. J. K. Catterson-Smith's very interesting paper of March 15th on the above subject, contains in fig. 5 a curve showing the no-load losses of a motor for various brush positions. In connection with some experiments concerning the influence of short-circuit currents on the magnetic field, which I carried out during the winter 1903—1904, I also tested several motors in the same way on light load, keeping the voltage and the speed constant. The curves so obtained were not symmetrical to the neutral line, showing a stronger increase of losses for backward shifting. The reason for this will be seen by following the different effect of the short-circuit currents on the field, which are weakening it for a backward position, and strengthening it for a forward position, thus causing a considerable difference of the exciting current for two positions of equal distance from the neutral line. The short-circuited conductors themselves are, therefore, moving in a correspondingly different field. One of these curves which also contains the exciting current can be seen on p. 36 of my recently-published pamphlet, "Uber Magnetische Wirkungen der Kurzschlussströme in Gleichstromankern." Stuttgart. Ferd. Enke.

J. Robert Pohl.

Thornbury Works, Bradford.
May 8th, 1905.

Ammonia from Peat.

I shall be obliged if you will allow me to correct an error in the reference in your issue of May 5th last to my connection with the Eschweiler-Woltereck process of ammonia manufacture.

My investigation was undertaken and completed when the formation of the original syndicate was in contemplation, and, at my request, an expert in industrial chemistry, whose name I suggested, was asked to make some further investigations.

We satisfied ourselves at that time that the process as carried out at that early stage was feasible, and sufficiently promising to warrant the formation of the syndicate as a speculative venture with every expectation of very large returns in the event of successful development to the commercial stage.

This development has occupied between two and three years, during which time it has received the unremitting personal attention of Dr. H. C. Woltereck, with the advice and assistance of his co-patentee, Prof. Eschweiler, and of B. E. R. Newlands.

At the time of my investigation, sulphate of ammonia was made in test tubes; it has now been made on a commercial scale, and under conditions which have proved definitely that, with the prices of labour and materials at the works now in course of erection, the cost of production will be less than half the present market price.

G. W. de Tunzelmann.

London, S.W., *May 9th*, 1905.

PARLIAMENTARY.

London County Council's Tramways.

On Monday the Examiner of Standing Orders had before him the new provision which the L.C.C. are seeking to incorporate into their Tramways Bills for this session, viz.:—"For the purpose of maintaining the service of tramcars in any street in which a tramway of the Council is in course of adaptation or reconstruction for working by electrical or other mechanical traction, the Council and their contractors, officers and servants, may lay, maintain and use upon the surface of any part of the roadway of such street, such additional line or lines of rails, as may be necessary, and the provisions of Sec. 25 of the Tramways Act, 1870, shall not apply to any such additional line or lines of rails, but such rails may be laid so as to project above the surface of the roadway to such extent as may be necessary, &c."

Mr. Browne (Parliamentary agent) represented the County Council, and Mr. Baxter appeared on behalf of the London General Omnibus Co., who opposed the application.

Mr. Browne at the outset asked if the Examiner would find whether the clause was one which had reference to second class works or not. If it was decided that it did not come within the category of second class works, then he maintained that the allegation of the opponents fell to the ground.

Mr. Baxter said he made two allegations. First, he alleged that the notices were late, and that would apply whether the works were first or second class works. His second allegation was that these temporary tramways which it was proposed to put down were really tramways of the second class, and in respect of which he contended that plans should have been deposited. By the present Bill the County Council would have power to lay tram rails along the street and really construct a series of tramways while the old tramways were being reconstructed. This they sought to do without putting in any plans or giving any notices or getting the consents of any of the local authorities. Although they were called temporary tramways, yet the County Council could keep them there any length of time. The Council also sought to vary the Tramways Act, which said that the rails should not be above the surface of

be street, for in this way those who used the streets could be put to great injury. There had been a case before the Law Courts, when it was decided that the County Council had no power to do this, and now they were coming before Parliament to get the necessary power.

Mr. Browne said the clause clearly showed that what they proposed to do was in no sense a tramway, but was merely work incidental to the reconstruction of the existing tramways. A tramway meant rails laid in the roadway, and intended to be there practically for all time.

The Examiner said he understood the Council already had the power to reconstruct the tramways for electrical traction.

Mr. Browne said they had that power under the Act of 1900, and until this case in the Courts was decided, they fully believed they had the power to make these temporary lines as they had done in the past. They laid down temporary rails for the purpose of preserving the service, and now that the law had decided against them, they wanted to put the matter right, so that the work of reconstructing the tramways might not be delayed, and the tramway service not be stopped. There were a number of cases in which it had been held that such works did not come within the category of works requiring the deposit of plans. This clause was an important one, inasmuch as it applied to the whole system of tramways in London so far as they had not yet been reconstructed for electrical traction, and it would affect nearly 100 miles of tramway. It would be absolutely impossible to deposit plans showing temporary lines of rails in connection with the reconstruction of the existing tramways.

Mr. Baxter: But I would point out that to have 100 miles of rails above the surface is a most dangerous thing.

The Examiner said that without going into the question whether this work was right or not, he was quite clear that it did not fall within the category of second-class works, and he could only report a non-compliance in respect of late notices.

Mr. Browne urged in support of his contention, that the Examiner should rule the whole memorial out, so that the memorialists would be unable to present a petition to the Standing Orders Committee.

Mr. Baxter asked that the Examiner should not give a decision which would shut him out from the Standing Orders Committee.

After further argument, the Examiner said he should simply report in the usual way to the Standing Orders Committee, that the Standing Orders with regard to the notices had not been complied with.

Paisley District Tramways.

On Friday, May 5th, in the Justiciary Buildings, Glasgow, a Parliamentary Committee, consisting of Mr. Eugene Mason, M.P. (chairman), Lord Stanley of Alderley, Sir John Batty Tuke, M.P., and Mr. John Fleming conducted an inquiry under the Private Legislature Procedure (Scotland) Act, 1899. The first order taken was the Paisley District Tramways extension.

Mr. Johnston, K.C., on behalf of the promoters, said the purpose of the order was to obtain power to extend certain existing systems of tramway lines. In 1901, the promoters of an order obtained power to make 10 different lines of tramways. They were all either within the burgh of Paisley or connecting Paisley with Renfrew on the one side and Johnstone on the other. Glasgow had running powers to the Cross of Paisley, and there was a continuous service of Glasgow cars from the centre of Glasgow to the centre of Paisley. The most important feature of the proposed order was power to connect Barrhead on the south with the present tramway line, and to carry the Johnstone line to Kilbarchan. The promoters were really following the policy which dictated the original conception of the lines, and which was approved by the Commissioners who sat on the original Bill. The order also sought power to extend the time for making certain lines granted in the first order, and to abandon other portions of the original scheme.

The order was opposed by the Caledonian, Glasgow and South-Western and Glasgow and Kilmarnock Railway Companies, and the National Telephone Company, all of whom were represented by counsel.

The first witness was Mr. Johnstone Smith, one of the directors of the Paisley District Tramways Co. He said that during the past six months 4,340,573 passengers were carried over the present system, and they expected a large increase on those figures in the summer months. Fifty cars ran between Paisley and Johnstone. The object of the order generally was to increase the usefulness and effectiveness of this particular route, and give them a more natural terminus. They had found great utility in connecting Paisley and Renfrew with the working towns on the opposite side of the Clyde by running the lines down to the ferry.

By Mr. Guthrie, K.C., for the Glasgow and South-Western Railway Co.: The people carried by the railway companies were so few that these companies would probably gain by their other traffic being fed by the additional tramway facilities.

Mr. Frederick Coutts, manager of the tramways, said that the working expenses came out at about 5½d. per car-mile.

After other evidence had been led in favour of the order, the case for the objectors was heard.

Dr. David Murray, solicitor to the Glasgow and South-Western Railway Co., examined by Mr. Guthrie, said that the extension of the tramway system, as proposed in the order, would be detrimental to the interest of the railway company. It was, he considered, most unreasonable to propose to extend the tramways, seeing that the railway companies had, within the last few years, constructed their railways on precisely the same evidence as had been led for the tramways that day.

Mr. Robert Millar, general manager of the Caledonian Railway Co., said that the Caledonian line between Paisley and Barrhead would be opened for traffic on June 1st. To date it had cost £720,000. There was not sufficient traffic to justify two railways and a tramway in the district.

By Mr. Johnstone: When the cars began running from Glasgow to Cambuslang, the railway passenger traffic between these two points went down almost immediately by 50 per cent.

The inquiry was resumed on Saturday, the 6th, when evidence was heard on behalf of the National Telephone Co. Mr. Lamb, district manager of the Paisley and Greenock section of the company's system, stated that the proposed tramways operations would necessitate the raising of the company's wires. The National Telephone Co. contended that they were entitled to recover the cost of this alteration from the promoters of the order.

Mr. William Allan, electrician, of the National Telephone Co., was examined as to the effect of the proximity of trolley wires to the telephone wires, and the necessity of raising the telephone wires.

The preamble of the Bill was found proved. The protective clauses sought by the Telephone Co. were disallowed.

Shropshire and Worcestershire Electric Power Bill.—The Great Western Railway Co., the Bridgeworth Corporation and the Oswestry Corporation have withdrawn their opposition to this Bill.

Electric Lighting Provisional Order (No. 3) Bill.—On Monday the Examiner of Standing Orders found that the necessary requirements had been complied with in the case of the above Bill, which confirms an electric lighting order granted to the Borough Council of Woolwich.

Electric Lighting Order Confirmation (No. 5) Bill.—On Monday the Examiner of Standing Orders had before him the above Bill, which confirms orders to the following districts:—Andover, Tunstall, Hesale, Litherland, Little Hulton, Penmaenmawr, Ravensthorpe, Stratford-on-Avon, Surbiton, Tewkesbury.

Scotch Electric Lighting Orders.—Mr. Campion, the Examiner, on Monday found that the necessary Standing Orders had been complied with in the case of the Electric Lighting Provisional Order (No. 4) Bill. The Bill confirms the following orders:—Denny and Duniface, Grangemouth, Inverness, Pollokshaws, Renfrew, Rutherglen and Uphall.

Wigan Corporation Tramways.—On Monday the Examiner of Standing Orders had before him the application of the Wigan Corporation for an additional provision to their Bill of this Session, the object of which is to obtain power to construct a tramway about 1 mile 1 furlong in length, situated in the urban district of Aspull, at a cost of £13,000. The consent of the Urban District Council of Aspull was produced, and there was no opposition. In consequence of late notice, the Examiner was bound to report a non-compliance with Standing Orders, and the matter will now come before the Standing Orders Committee.

London County Council Tramways Bill.—The South-Eastern Railway Co., the London and Chatham and Dover Co., and the South-Eastern and Chatham Railway Co.'s managing committee have withdrawn their opposition to the above Bill.

West Cumberland Electric Tramways.—This Bill came before the Unopposed Bills Committee of the House of Commons on Thursday last week, and was passed and ordered for third reading.

Electric Lighting Confirmation Order Bill, No. 1.—This Bill, which confirms a number of provisional orders granted by the Board of Trade, came before the Examiner of Standing Orders on Thursday last week. The Bill grants the following orders:—Bury, Conway, Golborne, Haydock, Little Lever, Southall-Norwall, Spalding, Whitwood and Whitworth.

London United Tramways (Extension of Time) Bill.—This Bill came before the Unopposed Bill Committee of the House of Commons on Thursday last week. Evidence having been given by Mr. Clifton Robinson, the Committee ordered the Bill to stand for third reading.

The London Electric Power Bills.—Earl Camperdown's Committee resumed its sittings on Tuesday, when Mr. Balfour Browne opened the case of the City of London Electric Lighting Co., with which has been consolidated the Bill of the East London and Lower Thames Valley Power Co Owing to pressure upon our space this week our report of the proceedings is held over.

Electrical Contractors' Association (Leeds Branch).

—The annual general meeting of this branch was held at the Great Northern Hotel, Bradford, last Saturday afternoon. Mr. P. Norman Hirst presided, and there was a good attendance of members. The annual report and balance-sheet were adopted, and the following officers were elected for the ensuing year:—

Chairman,	*Vice-Chairman,*
Mr. W. P. Steinthal.	Mr. J. H. Taylor.

Mr. E. C. Wallis, though anxious to retire, was re-elected secretary, it being felt that his retirement would be a very serious loss to the branch. He consented to act for another year.

The meeting was followed by a dinner, to which several guests were invited. Mr. W. P. Steinthal, the new chairman, presided. The guests present included Mr. Rolles and Mr. Allsopp, of the Bradford Corporation Electricity Department, and Mr. E. T. Steinthal, a member of the Central Board of the E.C.A. Letters of apology for unavoidable absence were read, amongst others, from the city engineers of Leeds and Bradford, and from Mr. McDermott, President of the Northern Section.

LEGAL.

THE MAYOR, ALDERMEN AND BURGESSES OF THE BOROUGH OF SWANSEA *v.* THE NATIONAL TELEPHONE CO., LTD.

THIS case came before Mr. Justice Buckley in the Chancery Division on Wednesday last week. It was an action by the plaintiffs claiming a declaration that under and by virtue of Sub-sec. 5 of Sec. 3 of the Telegraph Act, 1899, and an order made by the Postmaster-General pursuant thereto, and in the events which had happened, the plaintiffs were entitled to be afforded by the defendants all proper facilities for "restricted intercommunication" within the meaning of the order between the respective telephonic systems of the plaintiffs and the defendants, and that the defendants were bound to connect the telephonic lines which had been laid by the plaintiffs with the central switchboard in the defendants' telephone exchange in the borough of Swansea, and by means of such connection to afford to the subscribers of the plaintiffs the same facilities for such intercommunication as were given by the plaintiffs to the defendants' subscribers.

The plaintiffs also asked to have it determined what further works ought to be done and by whom for securing material intercommunication between the respective telephone systems of the plaintiffs and defendants as contemplated by Sub-sec. 5 Sec. 3 of the Telegraph Act, 1899, and the order, and how the cost of all works done, or to be done, for securing such intercommunication ought to be borne. The plaintiffs also claimed damages.

Shortly after September, 1902, the plaintiffs provided and had since worked in the Swansea area a system of public telephonic communication in competition with the defendants. On January 1st, 1904, the plaintiffs requested defendants to give "restricted intercommunication" within the meaning of the order between persons using the plaintiffs' system and persons using the defendants' system in the Swansea area in accordance with the provisions of the Telegraph Act, 1899, and the order, and satisfied the Postmaster-General that they possessed the required number of *bond fide* subscribers actually working. The plaintiffs, for the purpose of establishing intercommunication between the two systems, had laid telephonic junction lines from their telephone exchange in Swansea to a point opposite the defendants' exchange, and alleged that it was proper that their telephonic junction lines should be connected with the defendants' central switchboard in their exchange in Swansea. The plaintiffs' case was that the defendants declined to make the connection or to afford the plaintiffs any facilities for such "restricted intercommunication," sometimes alleging that, unless the plaintiffs first provided and connected junction circuits between plaintiffs' principal exchange in Swansea and each of the defendants' exchanges in the Swansea area and also junction circuits between the respective exchanges of the plaintiffs and defendants both at the Mumbles and at Morriston, they were not bound to afford to the plaintiffs any facilities whatever for intercommunication between the said respective systems. In order to have these questions determined, the plaintiffs commenced the present action, and claimed the relief before stated.

Mr. Buckmaster, K.C., and Mr. R. J. Parker appeared for the plaintiffs, and Mr. Danckwerts, K.C., and Mr. Astbury, K.C., for the defendants.

Evidence was given for the plaintiffs that the scheme proposed by the company would involve a waste of money. The witnesses stated that, in their opinion, all that was necessary was to connect the two central exchanges and make further connections as they were required.

Mr. ALFRED R. BENNETT, M.I.E.E., gave evidence for the plaintiffs to the effect that he supervised the laying of the Swansea Corporation system. The cable of that system was laid within a few feet of the defendants' exchange. No trouble or difficulty would arise if the systems were connected. He had never heard such a proposal as that of the defendants, which would occasion unnecessary expense.

In cross-examination, WITNESS said a great point of telephone management was to avoid delay to subscribers. He did not agree that the proposal of the Corporation would cause delay. What made for the efficiency of one system would make for the efficiency of the other. In his opinion the parties should agree as to the cost of one cable, and divide it.

Col. R. E. CROMPTON, M.I.C.E., past-president of the Institution of Electrical Engineers, agreed with the evidence of the last witness.

Mr. MACKIE, Corporation telephone manager at Swansea, gave evidence as to the work done at the Swansea Exchange.

Mr. MCFIE, Glasgow Corporation general telephone manager, gave corroborative evidence, and in answer to the judge, said that what the defendants wanted to do was practically to duplicate the lines.

This was the case for the plaintiffs.

On Thursday Mr. ASTBURY, K.C., opened the case for the defendant company. He said this matter had been fought as though the National Telephone Co. were intentionally obstructing a right the Swansea Corporation had to mutual intercommunication. It was nothing of the kind. The defendants were a very large company carrying on their business in practically every town in England, and, of course, their first duty was to their own subscribers. The arrangement made by the Telegraph Act of 1899, and that which would have to be made in every town, were matters of as much importance to the defendant company as to the various corporations who wanted intercommunication. There was no desire of any kind on the part of the defendant company to in any way obstruct or hinder the right of the plaintiffs to have such mutual intercommunication as they were entitled to. Intercommunication when given would cause considerable expense to both parties, and it was fair that the defendant company should not be put to the extra expense unless there was some guarantee that the subscribers in the applicant company were likely to continue. The plaintiffs had satisfied them as to that. The Act of 1899 contemplated that the Postmaster-General might, within six months from the passing of the Act, lay down the terms and conditions on which the intercommunication should be brought about. If he laid down conditions they must be observed, but if he did not (as was the fact), then the terms and conditions on which intercommunication should be effected were a matter for agreement between the Corporation and the company. He submitted there was no jurisdiction for the Court to grant a mandamus.

His LORDSHIP pointed out that the plaintiffs had a statutory right of intercommunication.

Mr. ASTBURY agreed, but said that if the offer of the company was fair and reasonable, the Court could not say that they had refused to comply with the requisition. Reasonable facilities did not mean that the company were to pay for poles and the pulling up of streets. The company suggested that the plaintiffs should bring their subscribers to each of their exchanges. He asked his Lordship to say that the offer of his clients was a fair and reasonable offer to afford proper facilities within the meaning of the Act. Evidence would be given to show that the company's system at Swansea was in such a condition that they had insufficient junctions between their exchanges, and that if his Lordship made the order that the plaintiffs asked, the company's business at Swansea would be thrown into confusion, and they would be unable to carry out their obligations under the statute. The company's contention was that all messages the Corporation brought to them must be brought to the switchboard of the subscriber to whom it was wished to speak, and that the company should do the same.

Evidence was then given for the defence.

Mr. F. GILL, chief telephone engineer of the defendant company, gave evidence as to the arrangement of telephonic wires in Swansea, and the effect of the junction proposed by the Corporation. The result of the Corporation's proposals, he said, would be to very seriously deteriorate the service of the company's subscribers. He suggested that the plaintiffs should bring their subscribers up to the switchboard belonging to the subscriber to whom it was wished to speak, and the company should do the same. Whatever the expense of that was to the plaintiffs, it would be the same to the defendants.

Mr. H. LAWS WEBB, another expert, also gave evidence, which was corroborated by the Swansea district manager of the company.

Mr. W. E. L. GAINE, the general manager, was giving evidence to the same effect, when the hearing was adjourned until Friday.

On Friday, Mr. GAINE said it was not correct that he had put forward certain points as a mere excuse for not affording the Corporation facilities. The competition between the Corporation and the company at Swansea had been very active and hostile, and he felt entitled to take all points he could in favour of his company. The objections he took, he believed, were perfectly good, but when the Postmaster-General came to a different conclusion he withdrew them. The company was perfectly ready to carry out the Telegraph Acts, and the difference between the Corporation and the company was only what means should be adopted to secure intercommunication. Swansea was an important telephone centre, using the telephone in a much greater degree than many other places. He thought the company's proposals were the only ones by which intercommunicating messages could be brought about between the parties. No intercommunication between the rival systems was worthy of the name, unless there was going to be good will and co-operation in carrying it out.

Cross-examined: He had never been anxious to allow the plaintiffs to intercommunicate with the plaintiffs' system. In his opinion the Corporation ought to increase the junction circuits for their originating traffic, and the company ought to do the same for theirs. He had taken up the position that until the Corporation acceded to the company's proposals, they would not allow intercommunication unless it was done as a whole.

Re-examined: He thought the Corporation's proposals meant that the company ought to bear the whole cost of both sets of originating messages.

His LORDSHIP said that the Act of Parliament seemed to have overlooked many important things. For instance, it said that facilities should be given for intercommunication; but nothing was said as to who should bear the cost.

Mr. BUCKMASTER said that the Act was framed for the purpose of protecting the subscribers and not the companies.

His LORDSHIP said that might be so. Still the weight of benefit conferred on subscribers to a small exchange would be greater than to a subscriber to a large exchange. There was nothing to provide for adjusting payment. Was not what Mr. Buckmaster wanted an inquiry as to what was necessary?

Mr. BUCKMASTER said he wanted more than that. He wanted proper facilities for intercommunication

His LORDSHIP said he could not go into every detail as to what was necessary. All he could do was to say that facilities should be given and order an inquiry as to what were proper facilities. He could express an opinion as to certain things being desirable.

Mr. BUCKMASTER asked that it should be declared that connections between the two systems at Swansea, Morriton and the Mumbles were proper facilities, with liberty to apply later if further facilities were thought by either party to be necessary.

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His Lordship reserved judgement.

His Lordship delivered a detailed judgement yesterday (Thursday) morning, declaring that plaintiffs were entitled to be afforded by the defendants all proper facilities for restricted intercommunication within the order between persons using the defendants' system and persons using the plaintiffs' system, and he declared that the defendants had improperly refused to give such proper facilities. There would be an order that the defendants do give such proper facilities, and there would be liberty to apply. Defendants must pay the costs of the action.

Back *v.* Dick, Kerr & Co., Ltd.

In the Court of Appeal on Friday the Master of the Rolls and Lords Justices Mathew and Cozens-Hardy concluded the hearing of an appeal by Dick, Kerr & Co., Ltd., from an award made under the Workmen's Compensation Act, by Judge Lush Wilson, K.C., sitting in the Exeter County Court. The company were contractors who had entered into a contract to take up the old tramway lines in certain streets in Exeter and lay down new rails for electric tramcars. The new rails were brought to Exeter by the London and South-Western Railway Co. to their Queen Street Yard, separated from the thoroughfare by means of a gateway. Some of the rails were taken from there to side depôts belonging to the employers, where they were stored, and the rest were, by an arrangement between the employers and the railway company, stacked and stored in the Queen Street Yard. The rails stored in the yard were taken direct from there to be laid in the streets. The contract contained no provision as to the place where the rails should be stored. Applicant was employed by the defendants in the Queen Street Yard in assisting to unload rails from a truck, and to stack them by means of a hand-crane, when he was injured by the accident. At the time of the accident the only work under the contract then commenced was that of taking up the old rails in the street on the St. David's station side of the Clock Tower, and about 700 yd. from the place where the accident happened. It was admitted that a tramway was a "railroad" within the definition of engineering work, but the question was whether the applicant was, at the time of the accident, employed "on, in, or about engineering work." The County Court judge decided in favour of the applicant, holding that the words included any portion of the selected area upon which the essential operations were conducted, and that the site upon which the rails were stacked in the yard was on, or in, or about the engineering work.

The appeal was brought on the ground that the County Court judge had misdirected himself by adopting the wrong principle.

Mr. O. Gutteridge appeared for the applicant, and Mr. W. Shakespeare for the employers.

At the conclusion of the arguments,

The Master of the Rolls, in giving judgement, said that to come within the Act the workman must be employed on, in, or about the physical area where labour of a certain class was being bestowed. In the present case the physical area of the engineering work which was actually being carried on at the time was about 700 yards from the scene of the accident. Unless it could be said that the railway yard was part of the physical area of the engineering work, the case did not come within the Act. In his Lordship's opinion it could not be said the County Court Judge had drawn the inference that the yard was part of the physical area, because he said that "although the word 'work' imparts definite locality as meaning the thing on which the labour is bestowed, I think the words 'on, or in, or about engineering work' must include any portion of the selected area upon which the essential operations were conducted." His Lordship was of opinion that it was not correct to say that any piece of land on which any incidental, though, perhaps, essential work was done, was, as a matter of law, part of the physical area of the engineering work. It was through a misdirection upon that point that the County Court Judge arrived at the conclusion that the railway yard, which was 700 yards away from the place where actual works were being executed, was part of the locality of the engineering work. It was his Lordship's opinion that the appeal succeeded, as there was no evidence that the place where the applicant was employed at the time of the accident, was on, or in, or about, the engineering works.

Lords Justices Mathew and Cozens-Hardy concurred.

The appeal was accordingly allowed.

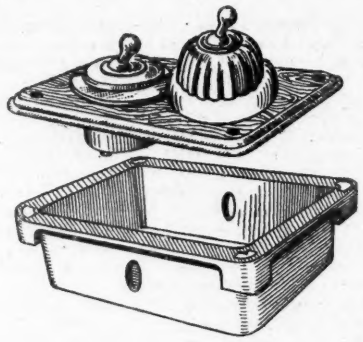
BUSINESS NOTES.

Electro-Metallurgical Industries in Norway.—It is announced that the large new enterprise for the magnetic treatment of iron ore at Dunderlandsdal in Norway is approaching completion. The electrical power station of 6,000 H.P. is ready, and so are the buildings for the magnetic separating plant which have been erected at the mines. The plant itself will soon be finished. The preliminary work at the mines has been done, and the railway to the harbour is out of the builders' hands. It is hoped that by the summer of the present year some 5,000 tons of ore will be treated every day, while the exportation for 1906 is expected to reach 750,000 tons. During the first 11 months of 1904 the amount of metallic zinc exported from the factory at Hafslund, where the De Laval electrical process is employed, reached 1,316 tons.

The Carbide Trade.—The Société pour la Fabrication du Carbure de Calcium of Gurtnellen made a net profit of 110,771 fr. as a result of last year's working. The Società Italiana del Carburo made a profit of nearly two and a quarter million lire, enabling them to pay a dividend of 28 per cent. In the Italian works the amount of carbide manufactured was 23,000 tons, in comparison with 20,000 tons during 1903.

Phœnix-Belliss Sets.—The Phœnix Dynamo Manufacturing Co., Ltd., have placed an order for two engines for driving an 150-KW. dynamo with Messrs. Belliss & Morcom, Ltd. These are for the plant for Messrs. W. H. Miers, Leeds, to the specification of Messrs. Shepherd & Watney, Leeds.

Inspection Boxes for Conduit Work. — Messrs. Wenham & Waters, of Paragon Works, Croydon, have devised, and provisionally patented, an arrangement for doing away with tapped holes and metal thread screws for fixing the covers of inspection boxes. These boxes are made with a wide flat flange, so that an india-rubber seating can be used for watertight work, and in



this flange are a number of pockets filled with soft metal which will take an ordinary wood screw. The covers of the boxes may be either of metal or wood to receive switches, &c.; the walls of the boxes are of sufficient thickness to take a thread for the conduit, and, owing to their shape, are self-moulding and inexpensive to produce. A large range of sizes are listed; they are so arranged that any make of switch, ceiling rose, &c., may be applied to the boxes without special provisions being made to receive same.

Morris-Hawkins Dynamos.—The report of the Morris Aiming Tube and Ammunition Co., Ltd., for 1904, says that the £10,000 of capital subscribed during the year was devoted to the erection and equipment of a factory, on the company's freehold land at Dagenham, for the Morris-Hawkins Electrical Co., Ltd., formed for the manufacture of electrical dynamos and motors. The progress already made in this new development of the business is said to point to beneficial results to the parent company.

The Islington Electrical Exhibition.—Mr. Albert Gay, the borough electrical engineer of Islington, has sent us some further particulars regarding the exhibition which is to be held at the Hornsey Road Baths from January 15th to 27th next. Every effort is to be made to render the show as attractive as it can be made for the general public, not only with electrical driving, lighting and heating apparatus, but with entertainments, swimming and diving competitions, model yacht races, electric boats, electric fountains and so forth. The catalogue will have a minimum circulation of 10,000 copies, and advertisements for it are now being sought. Full particulars as to space in the power and lighting sections, and regulations relating to same, can be obtained by applying to Mr. Gay, at 50, Eden Grove, Holloway, N.

Apprentice Premiums: Sentence. — On Monday Judge Rentoul, K.C., sentenced Sidney Fielder to six months' imprisonment with hard labour, and Owen C. Fielder was bound over to come up for judgement if called upon, on a charge of taking the son of one Esdaile as an apprentice to their business of "shopfitters and general electricians" in Hackney and not teaching him his trade. Other cases were also mentioned in which they had taken apprentices at certain premiums though no business was being done.

Germany.—Under the title the Witten Akkumulatoren Werke Gesellschaft a new company has just been formed at Witten with a capital of £25,000 to manufacture accumulators.

Imports of Foreign Electrical Machinery.—Returns just issued show that the imports of foreign electrical machinery into this country during last month attained a value of £51,064. This brings up the total for the four months ending with April last to £177,562, as against £178,924 in the corresponding four months of 1904.

Graphitic Carbon Brushes.—We learn that the Morgan Crucible Co., Ltd., Battersea, have lately taken up the manufacture of graphitic carbon brushes.

Browett-Lindley Engines.—The following are some of the more important orders booked by Messrs. Browett, Lindley and Co., Ltd., Patricroft, during April:—

From the Industrial Engineering Co., Ltd., Hyde, for the Shelton Iron and Steel Co., Ltd., one 150-KW. engine.

From the Newport Corporation, one 300-KW. steam dynamo, also one 200-KW. steam balancer, the dynamos being by the General Electric Co., Ltd.

From Messrs. Bruce Peebles & Co., Ltd., for Canadian electric tramways, one 250-KW. engine.

From the General Electric Co., Ltd., the jet condensing plant for the King's Lynn Corporation.

From Messrs. J. Birch & Co., London, for mill lighting in India, one 50-KW. set, including dynamo by Messrs. J. P. Hall & Co., Ltd.

From Messrs. Witting, Eborall & Co., for mill lighting in India, one 50-KW. engine.

From the British Thomson-Houston Co., Ltd., for the Hoylake U.D.C. Electricity Works, one 250-KW. engine.

From Messrs. J. H. Holmes & Co., for Messrs. Brookes & Doxey, Ltd., a tandem compound engine.

From the Fernhurst Spinning Co., Ltd., Oldham, one 1,400-I.H.P. three-crank triple-expansion vertical "Corliss" engine, for driving their mill by ropes.

From the Phœnix Dynamo Manufacturing Co., Ltd., one 300-KW. engine, for the Keighley Corporation; one 85-KW. engine for coupling to a three-phase generator, for a large Bradford mill; also an engine for coupling to a dynamo, for the West Riding County Council.

Catalogues and Lists.—MESSRS. ERNEST F. MOY, LTD., Camden Town. New list (No. 36), describing Moy and Bastie's return current circuit-breakers (single-pole) for continuous current circuits up to 600 volts.

THE ELECTRICAL CO, LTD., London, W.C. A number of new publications have come to hand from this company. No. 149 describes their twinkling socket for advertising signs; No. 150 illustrates and particularises the electrically-driven winding engine at No. 2 Preussen Pit; No. 151 gives a few figures showing "how to make electric light cheaper than incandescent gas," the course recommended being the use of Nernst lamps; Nos. 154, 156 and 157 give half-tone views, but no particulars, of three 75-KW. continuous current generators driven by gas engines at Limerick Corporation Electricity Works, also 240-KW. synchronous motor-generators and 720-KW. three-phase alternators supplied for Sunderland Corporation.

Mr. M. SEECK, 6, Henrietta Street, W.C. Price list of dry cells, carbon bag cells, pocket lamp batteries, &c.

MESSRS. ROTHERHAM & SONS, Coventry. Trade price list of lubricators, oil cups, grease cups, &c., for machinery, cycles and motor-cars.

THE C. W. HUNT CO, New York. Catalogue No. 055, detailing their coal-handling machinery for power stations, boiler-rooms, manufactories, &c. Numerous interesting illustrations appear.

CALLENDER'S CABLE AND CONSTRUCTION CO., LTD.—The new catalogue of cables just issued by this company must have involved an enormous amount of labour in its production, for it contains coloured diagrams and specifications and tabulated details of Callender cables of all descriptions. The various classes are:—Single conductor concentric and twin cables for low and medium working pressures (up to 660 volts); concentric cables for high pressures (up to 2,200 volts); triple-concentric, also three-core and three-phase for low and medium pressures; three cables for extra high tension. In each of these sections there are various sub-sections according to the sheathing, armouring, and so on, used. A most excellent arrangement consists in the use of coloured diagrams of cable sections, one of which appears on each alternate page facing the specification and tabulated matter which relates to it. An index to all of the colours used is given early in the book showing the different materials and metals represented by them, such as copper, bitumen, fibre or paper, lead, yarn, steel, bitumen tapes, braid and filling-in material. In the tabulated data there are stated the sectional areas of conductors, thicknesses of dielectrics and lead, overall diameters, code words, and prices per 1,000 yd. Further on in the book there is a series of feeder curves which are intended to give a ready means of arriving at a suitable area of copper conductors for most ordinary cases of supply feeders, those mentioned being for single conductor tramways, two-wire, three-wire, and three-wire three-phase feeders. Much matter of value is brought together in the general information section, and mention must also be made of the tables of weights, resistances, &c., of copper conductors, British standard tables, comparison of different wire gauges, and insulation and pressure tests. The work is an excellent one, and many electrical engineers will keep it handy for frequent reference.

CINCINNATI ELECTRICAL TOOL CO. (U.S.A.). List describing direct current portable drills and an electrical grinder.

MESSRS. WEBSTER & BENNETT, Atlas Works, Coventry. A very fine catalogue (95 pp. art paper) of modern machine tools, including boring and turning mills, multiple drilling, profiling and milling machines, also turret, screw-cutting, and brass-finishers' lathes. The half-tone illustrations, which are numerous, are of a very high class. The catalogue ought to be in the possession of tool-buyers and tool-users.

BRITISH THOMSON-HOUSTON CO., LTD., Rugby. Pamphlet No. 180 describing the B.T.H. Meridian lamp, and its advantages, and giving certain illuminating data.

MESSRS. J. C. LYELL & Co., LTD., 55, Victoria Street, S.W. Catalogue of motor-car accessories made in Patrick's metal, brass, and nickel. Charging boards, ignition devices, electric measuring instruments, contact breakers, &c., are shown and priced.

The Building Trades Exhibition.—The exhibition of the building trades, which was held at the Agricultural Hall, Islington, from April 27th to May 6th, was a large one, and very representative of the many branches of the industry. Among the exhibits there were many machine tools in operation. A number of firms connected with the electrical industry took space; amongst them we noted the Armorduct Manufacturing Co., Ltd., who made a good display of their "Armorduct" conduits and fittings, wires, electric lighting fittings, &c. The company also exhibited a new electric three-speed hand drill, and their stand was illuminated by four flame arc lamps, both of which new lines have been taken up recently by them. Prominently shown was a list of the large contracts which have been carried out with "Armorduct"; these include:—The London Coliseum; Waldorf Theatre, London; Olympia, Liverpool; L.C.C. Tramway Car-Sheds; Haymarket Theatre, London; Hippodrome, Manchester; York City Asylum; Wigan Corporation Public Baths; the Manchester Ship Canal New Transit Sheds, Manchester; and Withington Workhouse, Manchester. The amount of conduit that has been used in these installations, exceeds over half a million feet.

Messrs. Joseph Richmond & Co., Ltd., had a model of a "Richmond-Carey" patent automatic electric lift in operation, and showed other electric hoists, &c. Another excellent display of lifts and lift gears was that shown by Messrs. R. Waygood & Co., Ltd. Messrs. Crossley Bros., Ltd., had several of their well-known engines installed on their stand, one driving a small generator, and lighting their exhibit. One of their special high-speed electric lighting engines (oil) was also in operation. A "Harman" electric hoist, fitted with a 3-H.P. semi-enclosed motor, was shown by Messrs. R. Harman and Co.

Messrs. Heenan & Froude, the Horsfall Destructor Co., Messrs. Hughes & Stirling, and Messrs. Meldrum Bros., all took space for the purpose of exhibiting their various patents for the destruction of town refuse. Messrs. H. F. Joel & Co. made quite a large show with their Zone motors and dynamos. Another exhibit was that of Messrs. R. W. Blackwell & Co., Ltd., with the "Ruberoid" tubes, fittings, pumps, &c. Messrs. Bilbie, Hobson & Co., and the National Gas Engine Co., Ltd., also had some of their gas engines on view. Messrs. Babcock & Wilcox, Ltd.; Messrs. G. M. Callender and Co., Ltd. (bitumen sheeting, &c.); the J. Keith & Blackman Co., Ltd.; Mr. Arthur Koppel; Messrs. J. Defries & Sons, Ltd.; Messrs. Matthews & Yates, Ltd.; and the Medway Safety Lift Co. were also represented.

KEY ENGINEERING EXHIBITION.—An interesting exhibition of electrical and other machinery and apparatus was held in the Key Engineering Co.'s showrooms, Manchester, last week. The demonstration was very well attended; there were more than 400 visitors, most of whom were electrical men.

There was a good show of high tension switchgear manufactured under the Cowan-Andrews patents, and amongst other items there was in operation a high tension oil-break, mechanically operated switch panel with discriminating cut-out and current direction indicator, also an Andrews' patent reverse-current circuit-breaker. This circuit-breaker is an exceedingly well designed piece of switchboard apparatus, which operates with a small reverse current. There was also a model of remote control switchgear, time limit relay and regulating transformer, and other apparatus.

The fibre conduit is quite a new thing in conduit for cable laying in this country, though it has been used in the States for nearly 10 years. It is composed of a mixture of wood fibre, bitumen and paraffin wax, and when laid in concrete is exceedingly strong. It can also be laid direct in the ground. It is very light and easily laid, and is supplied with either screwed or socket joints. It is unaffected by heat or acid, so that when the mains become warm, they do not fasten on to the conduit and turn the system into a solid one, as is the case with some draw-in systems. Thirty-four miles of this conduit is being laid down by the Manchester Corporation at the present time. The advantages claimed for it are low cost, excellent mechanical protection, high insulation, and consequent freedom from electrolytic troubles, also small percentage of breakages, and the cable can at any time be drawn out, however long it has been laid. It was fully described in our issue of November 25th, 1904.

The Carbone Arc Lamp is an excellent lamp, giving an exceedingly steady light without casting shadows, and claims to give 40 per cent. more light than the ordinary type of arc lamp. The carbons are inclined at 120° to each other, and the voltage across the arc is 85, the current consumption being 11 amperes. Two lamps burn very steadily in series on a 200-volt circuit.

Messrs. Elliott Bros. had a good show of their well-known recording and other instruments. They are now putting instruments on the market which are interchangeable in every detail, and parts of which can be replaced from stock without the instrument having to be recalibrated,

Messrs. Reavell & Co. exhibited one of their electrically-driven air compressors. The compressor is double-ended, with the motor in the centre, all coupled direct on the motor shaft. Each compressor has four cylinders, which are connected on one crank-pin. The crank of one compressor is set at 45° with the other, giving 8 pulsations per revolution.

The Delafon Batteries Co. had a good selection of their different types of "Delafon Primary Battery," which is largely used in France for electric bell and telephone work. A battery was shown in operation working a high tension sparking coil for motor-car use. One of the most important features of the Delafon battery is that the electrolyte retains its humidity until the other part of the battery is practically done. Other exhibits included a "Harris" combined chemical and mechanical feed water filter, pneumatic tools, photographs of installations, &c.

Book Notices.—We have received a copy of the second number of *Electrics*, the new organ of the South Wales Electric Power Distribution Co., Ltd. The matter in this issue deals very largely with electric colliery installations and describes some of the

work of this character recently carried out in the company's area. As the chairman of the company announced at its recent meeting, the South Wales colliery managers are now adopting electricity in a very enterprising spirit. Mr. R. J. Wallis-Jones has an interesting and fully illustrated article particularising the Thomson electric welding process. Other topics touched upon are overhead transmission, colliery cables, and the progress that is being made at the various generating and sub-stations in the district supplied by the company. *Electrics* is a very creditable production.

Die Anwendung der Elektrizität für Militärische Zwecke. By Dr. Friedrich Wächter. A. Hartleben, Vienna. 3 M. This is a revised edition of a book originally published over 20 years ago, and it has naturally required to be practically completely re-written. It is more especially intended for the non-technical reader who wishes to obtain a general knowledge of the applications of electricity to military purposes, without requiring a detailed description of the apparatus and processes employed, from a strictly electrical point of view. In order to make the succeeding descriptions intelligible, the book commences with a short chapter on the general characteristics of electricity; then follow chapters on military telegraphy and telephony, ignition apparatus, electrical time measurement and electric lighting for military purposes. Each chapter combines an illustrated description of the better known pieces of apparatus, with an explanation of the purposes for which they are designed, and in this way the book gives a useful general account of the subject in a readable and popular manner.

Project for the Panama Canal. By Lindon W. Bates, 111, Broadway, New York. This brochure describes a project which, we understand, is now under consideration at Washington. Mr. Bates, in detailing his scheme, refers to the supply of lighting and power as follows:—"Electric power can readily be provided for the service of the canal, for its terminal cities, for its public utilities and industries. Pilots, however, responsible for the safe transit of vessels at night, will vastly prefer the system of placing a large searchlight on the stem of the ship 20 ft. below their positions on the bridge, to any system of canal lighting which only blinds their vision. During the construction period the writer does not advocate the use of electric power except for light and in shops. It will take too long to install such a system, and few, if any, land-excavating machines are yet through the experimental stage in trying to use electric motors as prime movers. Likewise he takes emphatic exception to the use of coal. In these tropics, coal burning requires too many labourers—men to unload vessels, to load and unload and transport cars, or barges, to load and unload wagons, to fire boilers, and to remove ashes. Instead, the writer proposes to install an oil-pipe line from Colon to Panama with tanks and pumping stations, with branches to Alhajuela and to all points where fuel will be necessary."

"An Inquiry into and an Explanation of Decimal Coinage and the Metric System of Weights and Measures." By Edwyn Anthony Second edition. London: Geo. Routledge & Sons, Ltd. 2s. 6d.

"British Standard Pipe Threads for Iron or Steel Pipes and Tubes." No. 21. Report issued by the Engineering Standards Committee; and "British Standard Screw Threads," No. 20. Interim Report issued by the Engineering Standards Committee. London: Crosby Lockwood & Son. 2s. 6d. net each.

The *Physical Review*, Vol, XX., No. 5. May, 1905. New York and London: The Macmillan Co.

We have received from the British South Africa Co., 2, London Wall Buildings, E.C., a publication entitled "Southern Rhodesia: Information for Settlers." It is full of matter, maps and photographic views, which should be of interest and value to those who, by inclination or necessity, aspire to settle in this very promising British Colony.

For Sale.—Messrs. Leopold Farmer & Sons will, on June 14th, sell some waterside premises, suitable for manufacturing purposes by auction. Aldershot U.D.C. has 24 Watson penny prepayment meters for sale. See particulars among our advertisements to-day.

Trade Announcements.—Mr. C. R. Heap, of 47, Victoria Street, S.W., has been appointed sole agent for London and 11 adjacent counties for the direct and alternating-current motors and dynamos and starting switches manufactured by Messrs. Hodgson Wright & Wood, of Halifax.

Messrs. Spurr, Inman & Co., Ltd., of Wakefield, have appointed Messrs. Umney & Peckett, of 46, King William Street, E.C., as agents for London and district for the sale of their boilers.

Liquidation.—A meeting of the Electrical Machinery Developments Co., Ltd., is to be held on Wednesday, June 7th, at 151, Cannon Street, E.C., to hear an account of the winding-up, from the liquidator (Mr. F. W. Lowther).

Meter-Reader's Sentence.—At Bow Street, Harry Martin, formerly in the employment of the Metropolitan Electric Supply Co. as a meter reader, has been sentenced to three months hard labour for being found on enclosed premises, supposed for the purpose of committing a felony. Prisoner left the service of the company in 1903, and since then there had been six complaints of the loss of articles from houses and flats after he had called there to inspect the meters, but, says the *Times*, no one would attend the Court to prosecute him.

New Mining Regulations.—Considerable discussion has been aroused by the stipulations contained in the new rules for the use of electricity in mines, which call for the installation of leakage indicators on the mains. The requirements are difficult to meet. We are informed, however, that Messrs. Everett, Edgcumbe & Co. are in a position to supply instruments which satisfy the conditions specified, for both D.C. and A.C. circuits.

Emsea Motor Starter.—This motor starter was described in connection with our notice of the Holborn and Finsbury Electrical Exhibition (p. 523), where, we believe, it was exhibited for the first time. The arrangement is such that the no-load and over-load releases (if the latter is used), control the movement of the switch-arm during the operation of switching on; no

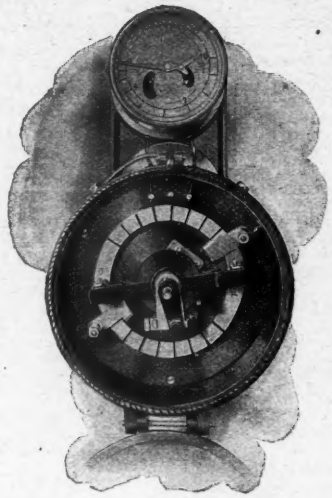


FIG. 1.

movement of the switch-arm taking place until the motor fields are excited. The overload release protects the motor from excess current rise, due to starting up too rapidly, and in combination with the resistances, ensures that the current rises shall not exceed 10 ampere steps up to 50 per cent. overload, thus rendering unnecessary the use of separate slow motion gears. A separate mechanical

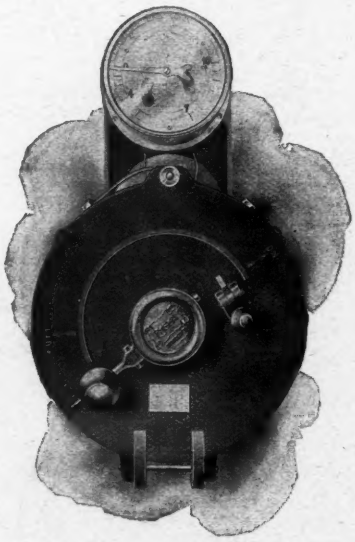


FIG. 2.

release trigger is provided for switching off, and the construction of the switch throughout, and its operation, are such as to commend it to all motor users. Figs. 1 and 2 illustrate the switch combined with Atkinson's patent adjustable time lag overload release, with the switch case open and closed respectively. Messrs. Monté-Callow & Co., of 6, Ludgate Broadway, E.C., are the manufacturers.

Electric Coal-Cutting.—The Yorkshire branch of the National Association of Colliery Managers held a meeting at Wakefield on Saturday afternoon last, at the Diamond Coal-Cutter Co.'s works. The two-phase motor equipments in the machine and erecting shops were inspected, also various types of disk and long-wall electric machines, and other electrical apparatus in progress. A working model of the Blackett patent underground conveyor system was also on view.

The Transvaal.—There was a large increase in the imports of electric wire, cables and fittings, into the Transvaal during January last, the returns just to hand showing a value of £20,000 as compared with only £9,000 in the first month of 1904.

Engine Contracts.—Messrs. W. Sisson & Co., Ltd., of Gloucester, have lately booked the following contracts for "Sisson" engines:—

One each 65 and 35-B.H.P., for South Africa, per Mr. A. Moir.
One each 272 and 60-B.H.P., for the General Electric Co., Ltd., Witton.
Four 19-B.H.P. single-cylinder engines, for Messrs. Wm. Harvie & Co., Ltd., Glasgow.
One 870-B.H.P. compound engine, from the Phœnix Dynamo Manufacturing Co., Ltd., for direct-coupling to a 600-KW. generator, for the Gloucester Electricity Works.
One electric light plant (per Mr. Burra for Mr. J. West), comprising one 23-B.H.P. single-cylinder engine, dynamo and direct-tube boiler, with all accessories, forming complete installation.
Two 10-B.H.P. single-cylinder engines, for the Sunderland Forge and Engineering Co., Ltd., Sunderland, for direct-coupling to "Pallion" dynamos.
One 40-B.H.P. and one 8-B.H.P. single-cylinder engines, for the India-rubber, Gutta-percha and T.W. Co., Ltd., Silvertown.

LIGHTING AND POWER NOTES.

African Notes.—PORT ELIZABETH.—The T.C. has accepted Messrs. Wills & Davey's tender of £8,935 for the erection of a power station in connection with the electric lighting scheme, subject to satisfactory sureties for the fulfilment of the contract.

CAPE GOVERNMENT RAILWAYS.—The report for the half-year, 1904, shows an expenditure of £6,215 on "electrical gear."

BULAWAYO.—The report of the Bulawayo Waterworks Co. Ltd., for the year ended 1904, states that receipts from the sale of electric light showed a decrease of £3,130. Recent reductions in railway rates have enabled coal to be used instead of wood as hitherto, and consequently a substantial reduction in the cost of fuel may be anticipated for the current year. The number of units sold amounted to 185,348, as compared with 201,725 in the previous year, and the number of consumers has decreased from 549 in December, 1903, to 515 in December, 1904. It is, however, hoped that this reduction is but temporary, and that the improved signs of trade revival will have its effect upon this branch of local industry.

EGYPT.—The electric light is to be installed on the new first-class bogie carriages which are to be supplied for use at Helonan.

Burnley.—The T.C. has decided to borrow the necessary money to cover the cost of an additional 500-KW. steam dynamo, to be erected at the electricity works.

Burton-on-Trent.—On May 4th, a L.G.B. inquiry into the application of the T.C. for a loan of £16,165 for electric lighting purposes, and to replace £6,000 excess expenditure incurred for electric lighting, was held, and there was no opposition.

Bury.—The net profits of the electricity undertaking of the Bury Corporation, for the past year, reached the sum of £2,931. The Council has not yet decided how the money shall be appropriated.

Canterbury.—At the meeting of the T.C. on May 3rd, it was reported that the net profit for the year on the electric lighting undertaking amounted to £205.

Cefn Mawr.—The P.C. has decided to ask the Llangollen E.L. Co.'s terms for supplying energy for public lighting.

Cleethorpes.—The U.D.C. has received from the L.G.B., sanction to raise a loan of £17,200 for the purchase of the generating station belonging to the Tramways Co.

Colchester.—The revenue of the electric light and power department of the Town Council (which is in its sixth year of working) has just been returned at £11,433; the working expenses of the year were £5,671, leaving a gross profit of £5,762. Out of this balance, £1,582 was paid for interest on loans, £1,694 for redemption of loans, and £53 was written off the pre-payment installation account. The net surplus for the year was accordingly £2,433. Private consumers took during the past year 426,229 units, which yielded £7,786, or an average of 4·36d. per unit. Public lamps took 87,373 units, which yielded £781, or an average of 2·39d. per unit. Tramway sales amounted to 286,205 units, yielding £2,266; the average price charged for this supply was 1·88d. per unit. Of the £2,433 representing the profit of 1904-5, £1,000 is proposed to be applied in reduction of rates, the final balance of £1,433 being carried to the reserve fund, which will then amount to £2,132.

The T.C. has received sanction to borrow £3,495 for electricity purposes.

The charges for energy have been reduced as follows:—General consumers, from 5d. per unit, to 4½d., less 5 per cent. for prompt payment; consumers guaranteeing to take over 5,500 units per annum, 4d. per unit, less 5 per cent.; street lighting, 2½d. per unit, for the first 50,000, 2d. for the second 50,000, and 1½d. beyond; tramways, 1½d. per unit. The War Office will be supplied at 4d. per unit.

Continental Notes.—SPAIN.—A concession has been granted for the erection of a water power plant at San Miguel on the River Tiron, for supplying electrical energy for lighting and power in the district.

ITALY.—An order has been applied for to put down a water turbo-generating plant on the River Lira at Isola del Lira, for electric lighting and power purposes.

A company, entitled La Societa per l'Illuminazione Elettrica Taranto, is about to erect an electricity works at Taranto at a cost of £8,000, for the lighting of the town.

GERMANY.—The A.E.G., Berlin, has secured the contract for the erection of an electricity works at Badorf.

Durham County.—The B. of T. has informed the C.C. that it has granted a prov. order to the Houghton-le-Spring and District E.L. Co. This action on the part of the Board seems to have somewhat disturbed the County Council. At a meeting on the 3rd inst. the Electricity Supply Committee reported that it appeared reasonable to assume that while the C.C. were endeavouring to develop a county scheme, it was the obvious duty of the B. of T. not to transfer the evolution of such an undertaking by handing over monopolies to private companies for a number of years. The question of promoting a Bill in Parliament for the scheme was adjourned until the next Council meeting.

The County of Durham Electrical Power Distribution Co. has given notice to its consumers that from July 1st prox. substantial reductions will be made in the charges for energy, as follows:—From 7d. and 2½d., one hour maximum demand, to 3⅜d. per unit; flat rate, less 5 per cent, for lighting, and from 4d. and 1½d. to 1½d. per unit, less 5 per cent. for power. The pressure of supply is also to be increased from 230 volts to 240 volts.

These reductions will, for the present, take effect only in Gateshead, Jarrow and Durham.

Eastbourne.—The opposition of the gas company, to the order being applied for by the T.C. to enable the Corporation to supply energy to Willingdon, has been withdrawn.

East Molesey.—Plans forwarded by the Twickenham and Teddington Electric Supply Co. for the laying of cables in 20 roads have been approved by the D.C., subject to the work being completed within three months from the date of its commencement.

Frome.—The L.G.B. has forwarded to the U.D.C., sanction to borrow £6,900 for electricity purposes, and £230 for the erection of additional public lamps.

Glasgow.—A memorial has been submitted to counsel asking their opinion as to the liability of an engineering firm in the city for damage done to several streets by the passage over them of exceptionally heavy boilers.

Godalming.—A difficulty has arisen with respect to the area supplied by the local electric lighting company. At the meeting of the T.C. on May 2nd, it was reported that the company had laid mains outside the area prescribed by the prov. order, and was supplying energy outside the area. The company wrote explaining that it was supplying a few consumers in the area of the Guildford Electricity Supply Co., with the consent of the latter, who were unable to give the supply owing to the great distance from the works at Guildford. The town clerk said the best thing to do was for the company to obtain an extension of the prov. order so as to include in the area of supply the district mentioned. The matter was eventually referred to the Lighting Committee.

Horsham.—The U.D.C. has received from the L.G.B. permission to borrow £4,820 for E.L. purposes.

Jedburgh.—The lighting of the streets by electricity was inaugurated on the 4th inst. Messrs. Crompton & Co. are the contractors.

London.—SOUTHWARK.—We regret that the last paragraph in our note last week, which stated that the Lighting Committee had decided to engage Prof. Kennedy to report upon extensions was, through a printers' error, inserted under Southwark; the Committee referred to was that of the Islington B.C.

ISLINGTON.—On the 5th inst. the B.C. adopted its E.L. Committee's recommendation to engage Prof. Kennedy to report upon the scheme to expend £15,500 upon extensions of the plant. There was some opposition to this suggestion at the meeting, and an amendment was proposed to the effect, that an expert be engaged to report upon the present state of the undertaking as a whole, but this was negatived by 35 votes to 22. A letter was read from the L.C.C. complaining of the high rate, 5d. per unit, charged for energy supplied to board schools. Other local authorities and public companies only charged 3d., 3½d. and 4d. The letter was referred to the Committee.

CITY.—In regard to the Corporation's decision to substitute gas for electricity for street lighting in certain parts of the City, Mr. Morton, the Chairman of the Streets Committee, on the 4th inst. stated that the present proposals were merely experimental, and that nothing further would be done in the way of superseding electricity until a year or two, when the citizens would have had experience of the high-power gas lamps.

WANDSWORTH.—An agreement has been come to between the B.C. and the County of London Electric Supply Co., with regard to the company's Bill now before Parliament. Clauses are to be inserted for the protection of the Council with reference to the buildings to be erected on land abutting upon Bell Lane Creek.

DEPTFORD.—On Tuesday, at the meeting of the B.C., an offer from the London Electric Supply Corporation to erect a

trial arc lamp, free of cost, and to remove it if required, was accepted.

THE METROPOLITAN AREA.—On the 19th inst. a conference, convened by the Metropolitan Paving Committee, of representatives of the City of London Corporation and the Metropolitan Borough Councils will be held to consider the inconvenience caused by street disturbances made by electric light and other public companies, and to formulate a scheme to give further power to local authorities for the protection of traders and the public generally.

Londonderry.—On the recommendation of its electrical engineer, Mr. R. V. Macrory, the Corporation has resolved to reduce the price of energy to consumers from 7d. and 2d. to 6d. and 2d. on the maximum demand system for lighting, and from a flat rate of 2d. to 2d. per unit for the first 500 units per quarter and 1½d. after, for power.

Macclesfield.—The T.C. has resolved to engage Mr. J. H. Woodward to act as consulting electrical engineer to the Council, subject to terms being arranged.

Middlesbrough.—The E.L. Committee of the T.C. reports that as a result of the last year's working of the E.L. undertaking, there was a net balance of £504, which is to be placed to the reserve account.

Middleton.—The Electricity Committee reports to the T.C. that the profit on the electrical undertaking, after allowing for financial charges, amounts to £750.

Nantwich.—The B. of T. has asked the U.D.C. what prospects there are of the Council giving effect to the electric lighting order, in the event of the Board deferring for a further period the question of revoking the order.

Nelson.—The T.C. on May 3rd reduced the prices of energy as under:—For lighting, up to 1,000 units per annum, 4d. per unit; 3,000, 3½d.; 5,000, 3¼d.; 8,000, 3d.; over 8,000, 3d. Motive power: first hour, 2½d. per unit, afterwards 1½d.

Newport (Mon.).—Application is to be made by the T.C. to the B. of T. at the suggestion of the L.G.B. for sanction to borrow £2,500, being part of a loan of £12,500, required for purposes of electricity supply, application to borrow which was made to the L.G.B. in March last.

Portsmouth.—The L.G.B. held an inquiry on Tuesday into an application of the T.C. for sanction to borrow £8,000 for extensions at the Electric Light Works, including a chimney shaft, water softening and pumping plant. There was no opposition.

Salford.—On May 3rd the T.C. decided to reduce the price of energy for power purposes to 1½d. per unit for the first 1,000 units per quarter, and 1d. per unit beyond. By this means it is hoped to considerably increase the day load.

South America.—SANTOS.—At the meeting of the City of Santos Developments Co. on 27th ult., Mr. D. M. Fox, M.I.C.E., who presided, said that the purchase of the tramways and electrical undertaking was completed on Feb. 21st, 1904, and it had been worked by the company for 10 months. The tramways showed, on the whole, good results, but the passenger traffic would have been larger but for the excessive rainfall (120 in. during the year). The electric lighting had hardly come up to expectations as yet; but this was mainly due to the fact that, under the advice of the company's consulting electrical engineers (Messrs. Mordey & Dawbarn), it had been decided to alter the whole system from the existing pressures of 2,000 volts and 110 volts to 3,000 and 220 volts respectively. It was also, on the same advice, decided to generate with gas engines and producer gas, as being much more economical than steam. The new plant, consisting of three 150-KW. alternators, driven by Westinghouse gas engines with producer gas, was now on order, and it was hoped that its erection would be completed during the next four months. On December 31st last there were 1,284 incandescent lamps of 16-C.P. in use for private consumers. The number of street lamps in the two Avenidas was 193. The electric lighting was at present confined—with the exception of a few lamps to some private consumers in the city—to the suburbs and the area outside that at present supplied by gas. It was anticipated that an additional 180 electric street lamps would be required in the near future. The introduction of ventilating fans in offices and dwelling houses in the city should prove a source of considerable revenue, especially during the summer months, when the climate of a land-locked place like Santos was rather oppressive. It was equally certain that there would be some demand for power purposes for coffee-cleaning machinery and small motors for various purposes. With only one of the three 150-KW. sets of plant at work, it was estimated that a net revenue of at least £2,500 per annum would be obtained. The estimated cost of the new electrical generating plant, buildings, cables, transformers and meters should not exceed £45,000.

An electricity supply is expected to be in operation in Tucuman by the end of August next.

The Andine Railway Co. intends lighting its station and shops at Rio Cuarto by electricity, and Messrs. Evans, Thornton & Co. have secured the order for the plant, which includes a Belliss engine of 32 H.P.

The Chivilcoy Municipality and Messrs. Trant & Soldani have come to terms in regard to the public and private lighting of the city. The output of the station at the start is to be 180 KW. Messrs. Burton, Cassini & Co. will carry out the construction work.—*Review of the River Plate.*

Steel Works.—The new electrical installation at the Wolsingham Steel Works is now in operation, the contractors being Messrs. Bruce Peebles & Co. Messrs. W. H. Allen, Son & Co. supplied the engines. There are some 13 motors, ranging from 5 to 75 H.P. each, and a large number of arc and incandescent lamps are installed.

Stockport.—The Gas and Electricity Committee has decided on the following hire charges for the use of motors:—For outside use and temporary use, 20 per cent. on the total cost; for inside use, 15 per cent. on the total cost, per annum.

Swindon.—A discussion took place at the meeting of the T.C. on May 2nd relative to the acceptance of tenders for free wiring of consumers' premises for the ensuing year. It was recommended that the tenders of Messrs. Hutton Bros., Mr. L. Howell, Messrs. Edwards, Bays and Rye, and Mr. S. Ferris should be accepted. It transpired that, although the whole of the tenderers' prices were alike, one of the firms mentioned originally sent in the lowest tender, but subsequently admitted that he had cut the price too fine for best material and workmanship. The Committee, thereupon, instructed the electrical engineer to decide the limit at which the work could be done, and that was the basis upon which the tenders were accepted, one tender being increased in price and the others lowered to the engineer's standard. Ultimately the question was referred back to the Committee.

Wellingborough.—The U.D.C. has signed a petition in favour of the Bill being promoted by the local Tramways and Electric Lighting Co.

Winchester.—The mayor last week opened an electrical exhibition organised by the Winchester E.L. & P. Co., and we gather that it has proved an attraction to the local residents.

Wolverhampton.—The Electricity Committee has decided to extend the lighting mains at a cost of £600.

TRAMWAY AND RAILWAY NOTES.

Aston.—The T.C. has resolved that, subject to formal approval by the Tramway Co. of the plans, specifications and conditions for the reconstruction of the tramways in High Street and Lozells Road, Witton, Wheeler Street and Birchfield, the tender of Mr. George Trentham for the execution of the work at the price of £46,294 10s. 5d. be accepted.

Barrow-in-Furness.—The borough electrical engineer has designed a piece of apparatus for cutting off the supply immediately any overhead trolley wire breaks, and the British Electric Traction Co. has practically decided to adopt it on the Barrow tramways.

Bexley.—The U.D.C. has resolved that application be made to the B. of T. for power to borrow a further sum of £5,000 for tramway purposes, and also to the L.G.B. for sanction to borrow £1,000 for purposes of electric lighting.

Bolton.—The small profit realised by the Corporation tramways during the past year gave occasion for some expressions of dissatisfaction at the last meeting of the T.C. The Chairman of the Tramways Committee, Mr. Alderman Miles, explained the position of the undertaking. The gross profit, he said, amounted to £40,564. But the interest on capital, sinking fund, repayment of mortgages and depreciation accounts were so heavy that the £40,000 was swallowed up except a small balance of £941. The working cost of the system was not excessive. The Committee had no control over the standing charges.

Bournemouth.—The Corporation tramway accounts for the past year's working show that the total income amounted to £56,323, and the working expenses to £33,592. After deducting capital charges, &c., there was a net balance of £5,201. The number of passengers carried was over 10 millions.

The T.C. has received from the B. of T. sanction to borrow £20,000 for tramway purposes.

Burnley.—The report of the tramway undertaking for the past year shows a gross profit of £13,433, and a net profit of £1,096, which goes to the reserve fund, increasing it to £7,841.

Bury.—At the last meeting of the Council the Parliamentary Committee was instructed to seek the necessary power to extend the lines to the Bolton boundary and also to join the Bury and Radcliffe lines.

Continental Notes.—GERMANY.—The report of the Berlin Elevated and Underground Electric Railway Co. for the past year shows that the undertaking has made slight progress, although it is improbable that any considerable development will take place until the proposed extensions have been carried out. The negotiations with the local authorities and others interested in the extensions proceed very slowly and hamper the undertaking. The number of passengers carried was 32,000,000 in 1904,

as compared with 29,500,000 in the previous year. The net profits amounted to £66,822, as against £57,523 in 1903, and it is proposed to pay a dividend at the rate of 4 per cent., as against 3½ per cent. in 1903.

SPAIN.—A company has just been formed in Brussels with a capital of £120,000, to be known as La Société des Tramways Electriques de Murcie. The Iberica Thomson Houston Co. and the Trust Franco-Belge de Tramways et d'Electricité are interested in the new undertaking.

ITALY.—A project to construct an electric tramway from Rome to Civita-Castellana is at present under consideration.

BELGIUM.—The balance-sheet of La Société des Tramways Electrique de Gand, Ghent, for the last financial year shows a loss of £12,644.

Dewsbury.—The T.C. has received from the B. of T. sanction to borrow £54,475 for the purchase of the Spen Valley Light Railways undertaking in the town.

East Ham.—The Tramways Committee has agreed to the following terms of the Barking Council for the leasing of its lines:—(1) That the charge for energy consumed be the same as for East Ham; (2) that if the charge per unit be reduced at any time from 1·75d. to 1·5d., the payment to Barking above the minimum of 83,000 car-miles per annum be at the rate of 2½d. per car-mile. The only point which remains to be settled is the length of the lease.

Erith.—The U.D.C. has decided to appoint a tramways manager, who shall be entirely responsible for the management and working of the system, at a salary of £250 a year.

Fire on an Electric Train.—Considerable alarm was occasioned on the electrified section of the Lancashire and Yorkshire Railway between Southport and Liverpool on Saturday evening. The 6.30 p.m. train out of Liverpool had run nearly half the distance to Southport, and when about half a mile off Formby, smoke was seen issuing from the rear carriage of the train—a third-class "smoker." Some of the passengers inside quickly noticed this, and were much alarmed. The guard reassured them, but a few moments later, before Formby had been reached, the train was suddenly pulled up, and the guard informed the passengers that they must make a hurried exit. In the meantime flames were making great headway in the lower portions of the burning coach. Sand was quickly procured from the power station at Formby, and this was thrown over the burning coach, the fire being in this manner ultimately extinguished.

Mr. H. E. O'Brien, resident electrical engineer at Formby, in the course of an interview, stated that an electric wire in the motor of the rear carriage snapped, and a short circuit was formed. Considerable smoke and flames arose from the cables, while there was some charring on the floor of the fourth carriage. There were 40 passengers on the train. Each train carries two fire extincteurs, together with bags of sand, which is plentiful all along the line, so that any electrical fire can be rapidly subdued. A periodical inspection of the wires takes place, but in consequence of this slight mishap, a special inspection of every coach has followed, without any further defect appearing. Several passengers express satisfaction at the kindly attention of the guard and his assistant with reference to their comfort, and the security of their parcels.

There was practically no panic, all the passengers leaving the carriages quietly and walking along the sidepath to Formby Station. The traffic on this section was suspended for 50 minutes, at the end of which the three uninjured carriages were sent forward to Southport, the full traffic being resumed. No delay occurred on the other sections.

Glasgow and Barrhead.—At a recent meeting of the T.C., it was reported that the negotiations between the Tramways Committee and the County Council of Renfrewshire for the extension of the line to Barrhead had been broken off, and in consequence this clause of the tramways extension order had been dropped.

A shield for the protection of tramcar drivers from the severity of inclement weather, has been erected on a car at Coplawhill Car Works, and the members of the Tramways Committee have agreed to inspect it.

Hull.—On Friday night John Sullivan, a stoker, was crossing the Holderness Road, near Williamson Street, Hull, intending to board a car which was going townwards, when he was struck and knocked down by an electric car which was proceeding in the opposite direction. The driver applied the brake, but there was no time to avert an accident. Sullivan was picked up unconscious and conveyed to the Royal Infirmary, where he was found to be suffering from a fractured skull and concussion. He died on Saturday.

Johannesburg.—Interviewed on the subject of the local electrical tramways by a representative of the *Transvaal Leader*, Mr. John MacDonald, the deputy town engineer, is reported to have said: "The foundations for the generating station are nearly completed, and the contract for the building itself was let about a fortnight ago. It will be pushed on with all possible speed. I expect the engine contractors will commence erecting the machinery in about three months' time. The cable-laying is being carried out under the superintendence of Mr. J. F. I. Thomas, the resident engineer for Messrs. Mordey & Dawbarn, consulting electrical engineers to the Johannesburg municipality.

Leeds.—At a meeting of the Tramways Committee of the Corporation last week, the general manager, Mr. J. B. Hamilton, stated that for the year ended March 25th last the total revenue amounted to £298,233, which worked out at 10·15d. per car-mile. The car-mileage was 7,044,838. The traffic expenses were £83,006, as against £79,870, an increase of 4 per cent. The cost per car-mile, owing to the improved traffic arrangements, had been reduced from 3·15d. to 2·82d., representing a saving in the working expenses of over £9,000. The total working expenses amounted to £161,297, leaving a gross profit of £136,936. From this had to be deducted £31,692, fixed charges for interest on capital outlay, £28,502 for redemption fund, and £21,743 for income-tax and depreciation, leaving £55,000, which the Committee resolved to pay over to the Finance Committee to be applied in relief of rates. Last year the total revenue was £280,563, and the expenditure £148,822, leaving a gross profit of £131,741 3s. 10d.

London.—DEPTFORD.—The B.C. on Tuesday received a letter from the L.C.C., stating that until a supply of electric power is available from the Greenwich generating station, it will not be possible to institute a direct service of cars between Deptford and Vauxhall. Plans were received from the Chief Engineer of the L.C.C. with regard to the Lewisham High Road tramways, showing certain widenings in the carriage-way by means of reducing the footway. The plans were approved, subject to the footway not being reduced to a less width than 9 ft. at any point.

MARYLEBONE.—Petitions from the inhabitants of Nottingham Place, Bickenhall Mansions, and other localities asking the B.C. to stop the nuisance of motor-omnibuses, having been referred to the Works Committee, that body reported on Tuesday to the effect that it had referred the complainants to the Royal Commission now dealing with the question of London traffic.

LEWISHAM.—A meeting of residents in Hither Green has passed a resolution calling for the extension of the L.C.C. tramways from Rushey Green to Lee Green.

Mansfield.—The local authorities affected by the Mansfield and District Light Railways Order, who have opposed an application for an extension of time in which to construct the works, have received a communication from the B. of T., stating that they have sanctioned an extension of time for six months from the 13th inst.

Middlesex.—The County Council on the 4th inst. approved of £28,460 being paid in respect of the purchase of property, &c., required in connection with Railway No. 6, and £214 in connection with Railways Nos. 2, 8 and 15. These amounts will make the net compensation paid in respect of lines under the 1901 order £143,839, and under the 1903 order £52,068. It was resolved that, subject to the approval by the B. of T. and the Hendon and Willesden U.D.C.'s of the plans, the construction of the portion of Railway No. 15 from its junction with Railway No. 5 in the Edgware Road to the Metropolitan Railway Station at Willesden Green, be placed in the hands of Messrs. Dick, Kerr & Co., at their present contract prices for the construction of Railway No. 6. It was mentioned that the Metropolitan Electric Tramways, Ltd., approved of this section, which would link up Willesden with the Edgware Road line, being constructed as speedily as possible. A supplemental estimate of £78,500, the increased cost (£121,500 to £200,000) of the construction of a double line in place of a single one from Waltham Cross to Enfield, and the price of additional land, was passed. A member of the Finance Committee asked whether it was probable that there would be relief to the rates soon, from this pouring out of hundreds of thousands of pounds, Sir F. Cory-Wright, chairman of the Light Railways Committee, replied that the tramways would not pay until they were joined one with the other, and the Finance Committee was to blame for not making the necessary funds available so that the work could be more quickly done.

Radcliffe.—On the 5th inst. the D.C. completed another tramway section, namely, the Black Lane route, which will eventually connect the town with Bolton. The trial trip was in every way successful, and the ordinary service commenced in the evening.

Rochdale.—On Saturday the steam trams ceased running; they will be superseded by electric cars, as has been the case with so many systems in Lancashire.

St. Helens.—The period allowed by the directors of the St. Helens Tramways Co. to the drivers and conductors on strike, to accept their offer of arbitration before noon on Saturday, passed without any change in the position, the men being determined only to consent to arbitration on the basis of a general average wage equal to the average wages of all the tramway workers in the country. The strikers are hopeful that the Corporation may intervene. The tramway officials, who now state that the strike, so far as they are concerned, is at an end, have withdrawn their offer. The men have been paid strike pay from the union funds.

At Friday's meeting of the Liverpool Tramway Committee, Mr. Lloyd (chairman of the Traffic Sub-committee) said the Sub-committee had been approached by the South Lancashire Tramways Co. to exercise the powers of the Liverpool Corporation to run over the company's lines between Knotty Ash and Prescot. In consequence of the difference between the St. Helens Co.—who had operated those three miles of track—and their men, the service had been rendered inefficient, to the disadvantage of the locality between Prescot and Knotty Ash, and to the inconvenience and

loss of the Liverpool Corporation. The Sub-committee's agreement to carry on the traffic was unanimously approved.

The service of cars between Sandhills and Prescot is materially improved by the Liverpool cars running to Brooks Bridge, Prescot; but the Haydock, Parr, St. Helens Junction routes, &c., are still practically idle.

The different sections of the St. Helens Trades Council, which embraces all the organised labour of the town, have decided to give the strikers financial assistance, and they have the assurance that there is a strong feeling among the trade unionists in Liverpool against the Liverpool Corporation taking over the working of the Knotty Ash section of the tramways, as it is contended that this is helping the company against the men.

An agitation is being commenced in St. Helens with the object of inducing the Corporation to take over the tramways, which it now leases to the tramways company.

South Shields.—At the meeting of the T.C. on the 3rd inst. the Electrical Committee reported the receipt of a letter from the County of Durham Electrical Power Distribution Co., Ltd., stating that before the Council finally decided to incur heavy capital expenditure, the company would like to have an opportunity of submitting a proposal for the supply of the necessary electrical energy for the tramways. The Committee instructed the Town Clerk to reply that having entered into contracts for additional plant, the Committee could not see its way to enter into negotiations with the company. The Tramways Committee recommended the acceptance of the tender of Messrs. Hurst Nelson and Co., Ltd., for 10 tramcars at a cost of £5,307, with Brill trucks. The report was adopted.

Walsall.—The Tramway Committee has intimated to the Pelsall Parish Council that it cannot entertain an application from that Council to extend the Corporation lines through Pelsall to Norton.

Wigan.—On the Ashton route of the Wigan Corporation tramways on Tuesday morning, at Worsley Mesnes, a car was waiting in one of the loops when one coming in the opposite direction jumped the points, and dashed into it. The drivers saved themselves by jumping off, but one of the two passengers received injuries, chiefly through broken glass. The front parts of both cars received considerable damage. A girl, who was suffering from injuries, was treated at the infirmary. She had been thrown into the street, and hurt her back. It transpires that the accident occurred in a fog.

Welshpool and Llanfair.—The Board of Trade has confirmed the Welshpool and Llanfair Light Railway (Further Borrowing Powers) Order, 1905, amending the Welshpool and Llanfair Light Railway (Amendment) Order, 1901.

TELEGRAPH AND TELEPHONE NOTES.

African Telegraphs.—The German Administration advises the opening of a telegraph office to international traffic at Msansa, German East Africa, and at Rehoboth in German South-West Africa.

Australian Telephones.—According to the *Sydney Daily Telegraph*, the Postmaster-General, Mr. Sydney Smith, has made a further move in the matter of extending the telephone services through the country districts. He is rapidly bringing Sydney within reach of the principal towns on the main lines of railway, and proposes to do more in the near future. The extensions have been rendered practicable by the use of the condenser in connection with existing telegraph lines. On March 7th communication was opened up between Sydney and Orange through Bathurst, and the voices could be distinctly heard over 192 miles of wire. The Bathurst circuit was complete some time ago; but Orange, a further distance of 47 miles, is only just finished. Here the condenser has been brought into use at the merely nominal cost of about £70. The original estimate for a separate telephonic service over this 47-mile stretch was £3,000. It may be remembered that the estimated cost of a service to Wollongong was originally £3,100, but connection was established through the condenser for £170, of which sum no less than £105 was absorbed in making the ordinary repairs to the line, which would have been necessary in any case. On the same date the Postmaster-General also ordered Cowra to be connected with Bathurst, and thus through to Sydney. This extension covers some 28 miles of new road, which has been bridged at a cost of something like £150, as against £3,600, which was the estimate of cost under the old system. Another project, which was to have cost £4,100 under the old system, has been developed for something under £200. Thus in these four cases it has been possible to save approximately £13,300 by using the condenser, as against the old system.

Brighton Telephones.—The accounts of the Corporation telephone department for the year ended March 31st show that the total debt created up to date is £45,489. The income for the year was £6,787, and the expenditure £3,802. After providing for interest on capital, sinking fund contribution, and bad debts, a profit is shown of £413.

Canadian Telephones.—The Special Telephone Committee held many further sittings during April, taking evidence regarding the working of telephone systems in various parts of Canada. Councillor Willocks, of Glasgow, gave evidence as to the benefits which he stated had followed the establishment of a municipal system in Glasgow.

Cape Colony Telephones.—According to a statement made in the Cape House of Assembly, the telephone revenue of the Colony had increased, during the last 10 years, from £6,300 to £43,000. Since January 1st last 165 new connections had been applied for, and there had been a number of inquiries for the establishment of new exchanges.

Overhead Wires in the City.—According to the *City Press*, since 1899 the Inspector of Overhead Wires in the City of London has removed 20½ miles of unidentified wires. During 1904 the derelict and unidentified wires removed were 131, having a total length of 8,915 yards of wire, together with insulators and attachments. In all, 790 notifications had to be given by the inspector to the owners of broken wires and other defective plant for contravening the bye-laws of the London Overhead Wires Act. In 530 instances defective material was alleged, in 72 cases the existence of broken wires formed the subject of the report, and on 188 occasions other contraventions were notified.

The number of overhead wires in the City has again greatly increased, in addition to the large number placed underground. In 1904 the number of private owners of overhead lines increased to 117, and of companies to 18, jointly possessing a total length estimated at 38,000 miles of overhead wires in the City, with about 682,000 spans crossing public thoroughfares, compared with 260,000 spans in 1899.

The value of the enforcement of the bye-law by the Corporation, requiring proper identification of all overhead wires erected in the City, has been apparent in the case of about 30 fallen wires reported by the police. The Inspector of Overhead Wires, upon being informed of the breakages, was able to identify the owners, and thus to obtain the immediate repair or removal by them of the fallen wire.

Hong Kong Telephones.—The *Hong Kong Weekly Press* says that the Telephone Co., in addition to opening an exchange in Kowloon, has resolved to reconstruct the entire system of telephone communication in the Colony at a cost of something like £10,000, and the work is to commence forthwith under the direction of the new manager, Mr. W. L. Carter. The reconstruction has been rendered necessary by the development of the tramways and the extension of the Electric Light Co.'s mains. The metallic circuit system is being substituted for the present earth return system. In the central portion of the city the cables are to be carried underground.

Hull Telephones.—Mr. H. Ross Hooper held a L.G.B. inquiry last week into the application by the Corporation for sanction to borrow £20,873 for telephone purposes. There was no opposition to the application, which was for extensions.

International Telegraph Line viâ Alaska and Siberia.—An American Co., called the "North-Eastern Siberia Co.," intends establishing a land telegraph system to join the United States, Siberia, China, and Europe. Permission has already been obtained from the Russian Government for the line, which will run along the north coast of Siberia, and will connect with the trans-Siberian Railway. The project provides that the American Government shall prolong its line to Alaska (already existing as far as Nome) to Cape Prince-de-Galles, where it is intended to establish a wireless telegraph station to communicate with Cape Oriental, the nearest point of Siberia to the American Continent, which is intended to be the starting point of the Russian line.

Lightships.—In the House of Commons, Major Seely asked the Secretary to the B. of T. whether the work of installing wireless telegraphy on the six lightships for life-saving purposes had now been commenced. Mr. Bonar Law replied that the agreement with the Marconi Co. had been finally settled, and the work of installation would be put in hand forthwith.

Marylebone.—The Works Committee of the B.C. reported on Tuesday having received a letter from the Secretary of the General Post Office with regard to a condition of payment attached to the Council's consent to the erection of a telegraph pole in Wellington Place, stating that, although the Postmaster-General is under the obligation to obtain the consent of the road authorities as a preliminary to the exercise of his statutory powers, he does not undertake to make any payment to such authorities in respect of telegraphs so constructed. The Committee recommended the Council to withdraw its consent to the erection of the pole in question.

The Telegraph Cable Export Trade.—April proved to be an exceedingly active month as regards the export from this country of telegraph cable and apparatus connected therewith. This branch of trade had been very quiet for a long period, but the shipments last month took a welcome turn for the better; they attained a value of £212,605, the best since March, 1903, and comparing with only £45,429 in the same month a year ago. For the four months ending with April the exports have amounted to £393,940, which contrasts with £289,265 in the corresponding period of last year, and £1,261,741 in the first four months of 1903.

Telephone Mouthpieces.—Fears having been expressed as to the danger of infection from telephone mouthpieces, the medical officer of the City of London had a number submitted to bacteriological examination; he reports that there is no real risk in the use of the telephone at public call offices, and that the alarm that has been raised has no foundation in fact.—*Daily Telegraph.*

(*Continued on page* 775.)

THE ELECTRICALLY DRIVEN SEMET-SOLVAY COKE PLANT OF THE WIGAN COAL AND IRON CO., Ltd.

THE Wigan Coal and Iron Co.'s very extensive works, near Wigan, have recently been equipped with a battery of 44 Semet-Solvay coke ovens and auxiliary plant, for the purpose of obtaining a more economical supply of coke for use in the blast furnaces. The auxiliary plant provides for the crushing and delivery of the fine coal, or slack, to the ovens and for dealing with the bye-products. The plant was erected in accordance with the designs and plans of Mr. John H. Darby, engineer, of Brymbo, near Wrexham; the three-phase electrical plant for driving the machinery having been installed by the British Westinghouse Electric and Manufacturing Co., Ltd., of London and Manchester.

Under the present conditions the washed slack, or fine coal, arrives in railway trucks. Elevators raise this coal and feed it through a hoppered regulating bin on to a Robins belt conveyor.

The latter consists of an 18-in. belt, which carries the fuel into a disintegrator house, where it is dropped through a shoot into the disintegrator or crushing machine. The disintegrator reels are carefully balanced, and their shafts have long bearings, with the result that there is no vibration when running. These reels run one within the other in opposite directions at an equal peripheral speed of about 7,000 ft. per minute, each

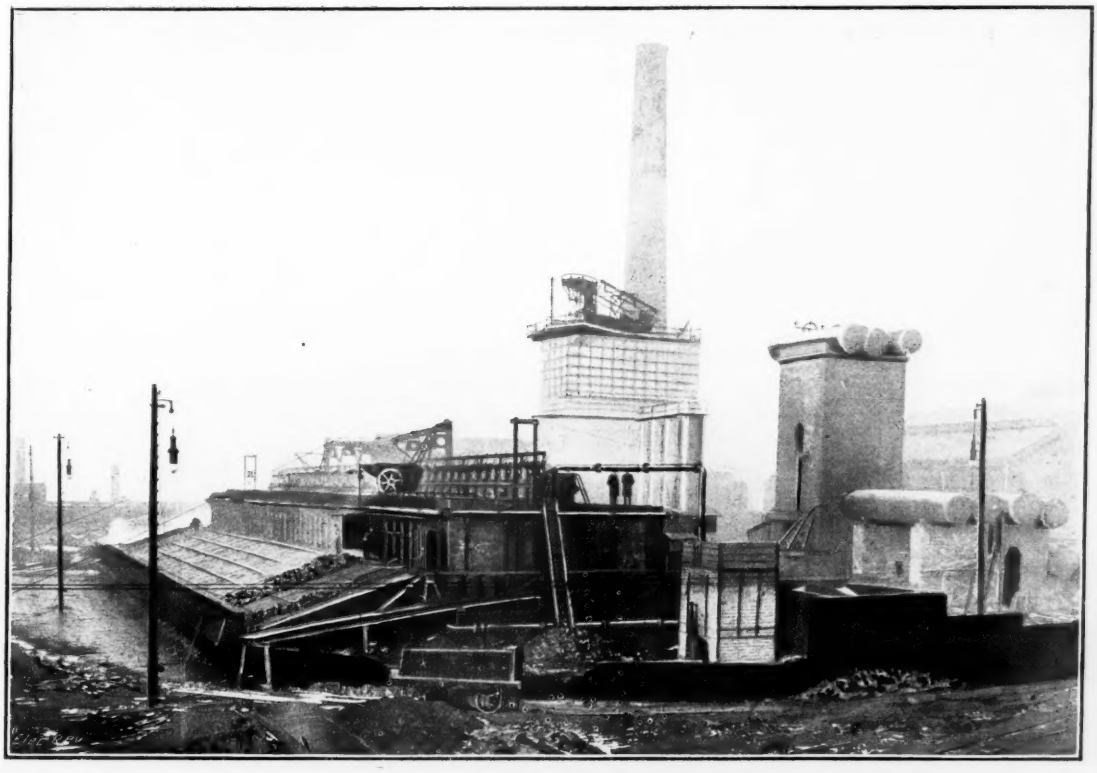


FIG. 1.—SEMET-SOLVAY COKE PLANT: WIGAN COAL AND IRON CO., LTD.

The greater part of this coke plant is electrically driven, the energy being furnished by two direct coupled Belliss-Westinghouse steam generators installed in the power house, a view of which is given in fig. 2.

The generators are Westinghouse three-phase alternators each of 175 KW. capacity, the pressure being 440 volts and the frequency 50 periods. Each machine has a separate belt-driven exciter, either of the latter being capable of exciting the fields of both generators in case of emergency.

The Belliss engines are of the vertical two-crank high-speed enclosed type, running at 375 r.p.m.

On the left of fig. 2 is the main switchboard, from which the current is led through four feeder circuits to the various motor switchboards; this stands well out from the wall, a door being provided for giving access to the back. The field resistances are in a separate compartment at the right-hand side of the board.

being independently belt-driven by a 60-H.P. Westinghouse motor. The disintegrator has a capacity of 30 tons per hour.

The powdered coal falls from the disintegrator through a shoot below into the "boot" of the main elevator, which lifts it up to a considerable height, and delivers it into a hoppered steel bunker of 90 tons capacity; this elevator, as well as the Robins belt-conveyor, is driven by a motor fixed in the disintegrator house. The powdered slack or coal is drawn from this bunker as required, and dropped through a hand-operated shoot into the buckets of an aerial ropeway having a continuous slow movement, which automatically empties it into a 200-ton steel storage bunker at the other end of the line. Beneath the top of the main elevator and the 90-ton bin is a raised shed, in which one end of the ropeway and its driving motor are housed; here also the ropeway buckets are filled. The ropeway travels upwards at

a considerable angle, and the delivery end of same, together with the large storage bunker, is shown in figs. 1 and 4.

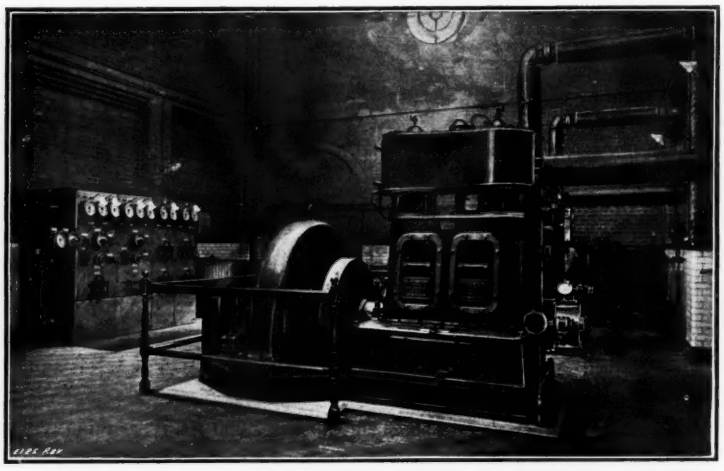


Fig. 2.—View of Generating Plant and Switchgear.

The powdered coal is drawn from the storage bunker through two hoppers (only one of which works at a time), which deliver it on to two revolving feed tables fitted with scraper arms, and it drops from these on to a Robins belt, the tables and the belt being actuated by a motor through suitable gearing. The belt conveyor is extended to span the track on which the coke oven chargers and rams run, at the front of the ovens, and it is roofed in and enclosed at the sides. Moving backwards and forwards along a certain length of the belt is an automatic distributing carriage, which delivers the coal from the belt into the compression box of one of the two charging machines, which are moved in turn into position under the distributor. This distributing carriage runs on about 28 ft. of rail track, and is operated by the belt itself, the gearing and direction of travel being automatically reversed by stops at each end of the run. Fig. 4 shows the storage bunker and the top of the distributing belt shed in the background, and one of the charging machine in the foreground. Moving up and down parallel with the distributing carriage, and mounted on the same girder span, are two stamping machines, each of which is driven by a motor. Each of these machines delivers 50 blows per minute on to the powdered coal in the compression box, the stamps travelling backwards and forwards between successive blows, reversing at the extreme ends of the compression box, and also at a varying point at or about the centre of the box. In each case the reversal is automatic, and the action both of feeding the powdered coal and stamping it is continuous, until the compression box is full. The construction of these stamping machines is wonderfully ingenious, and the energetic way in which they do their work is most interesting to watch.

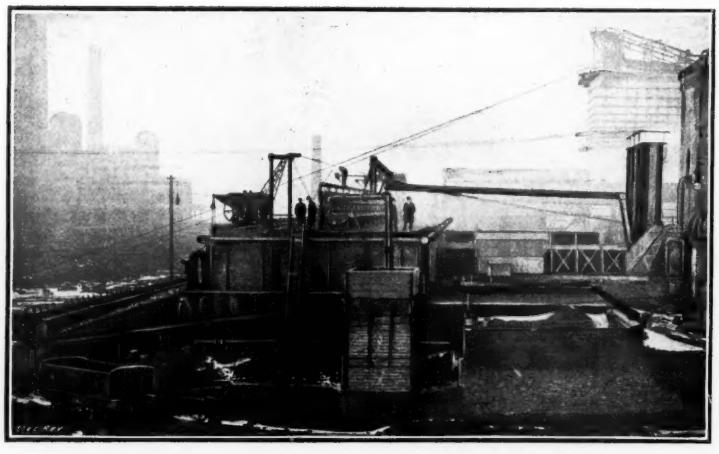


Fig. 3.—View of Ovens, with Charging Machine and Ram.

As already mentioned, there are two charging machines, each of which is moved in turn under the shoot of the distributing belt and the stamping machines. They consist of a large box or mould mounted on a carriage which travels along a rail track running in front of the row of coke-ovens, this travel being effected by a variable-speed motor, and the maximum rate of travel being 300 ft. per minute. This motor may be seen in fig. 4.

The bottom of the compression box consists of a charging "peel" or sliding slab, built up of steel sections, having a flat top for the charge of compressed coal to rest on and an inverted steel rack beneath; there is also a raised back at one end which forces the "charge" through the sides of the compression box. The rack is operated through reducing gear by an independent variable-speed motor, similar to the travelling motor, this second motor being fixed on the other side of the charger.

A machine, after having received its charge of compressed coal, is moved up to the front of the particular oven to be charged; the door at the front end of the compression box and the hinged door of the oven are opened, and the charging peel or sliding bottom of the compression box with its load of coal is put in motion, the coal being pushed into the oven in the form of a compressed cake, which fits the dimensions of the oven very closely. The peel is withdrawn after closing and fixing the oven door, there being a space below sufficient for the peel to be drawn through, and this space is afterwards closed up. The peel travels at the rate of 35 ft. per minute. At the back end of the charging machine (fig. 4) may be seen an arm supporting the collectors, through which

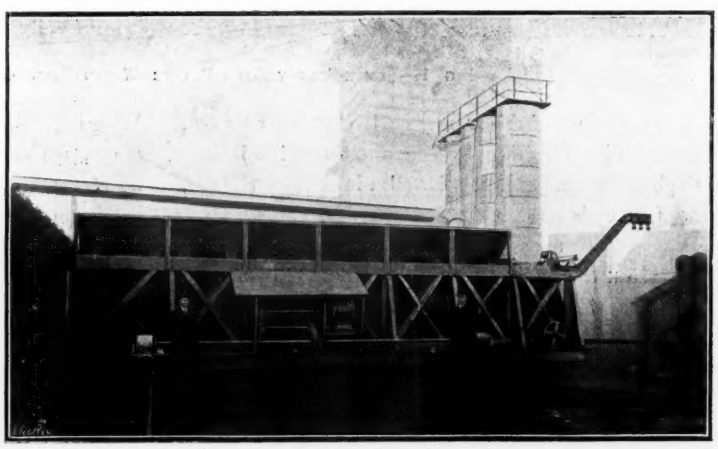


Fig. 4.—Electrically-Operated Charging Machine.

energy is drawn from the overhead three-phase circuits. These collectors are of a special pattern, and include special devices for the purpose of keeping the wires clean, a very necessary precaution considering the smoke which from time to time is emitted, when the ovens are opened.

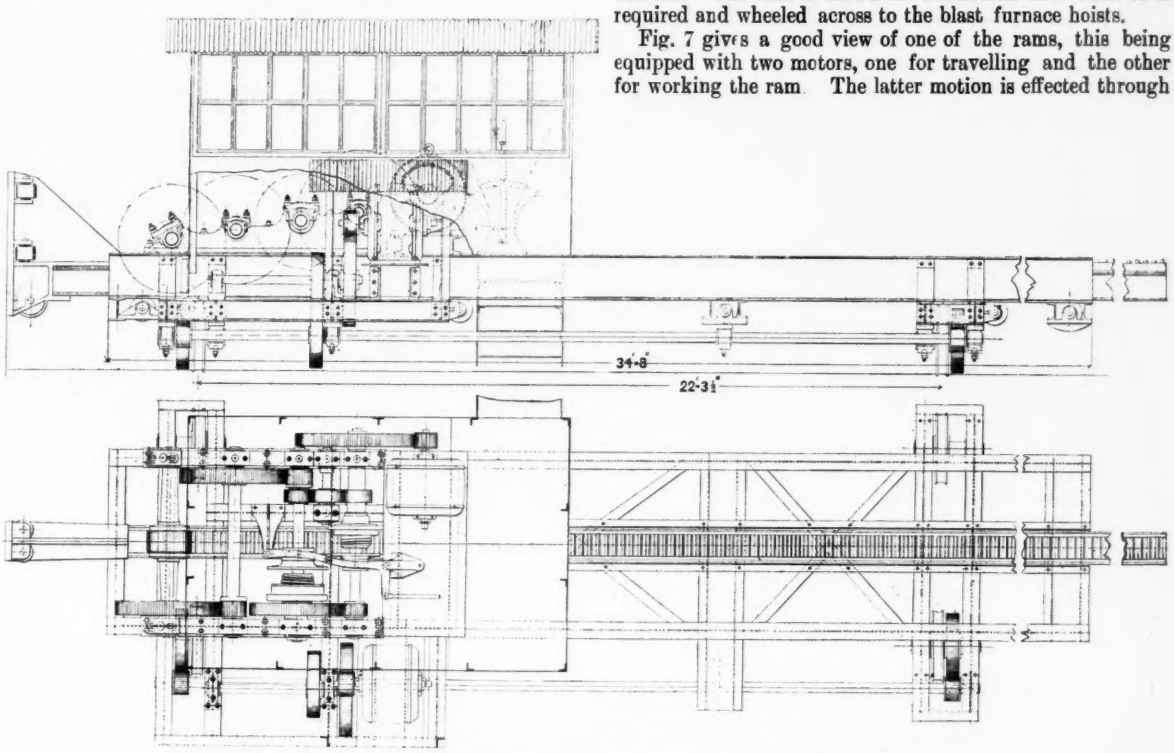


FIG. 5.—PLAN AND ELEVATION OF ELECTRICALLY OPERATED COKE-OVEN RAM.

The battery of coke ovens lies parallel with the line of blast furnaces, and two views of the same are given in figs. 1 and 3. Fig. 3 gives a good general view of the coke plant, with the exception of the disintegrator house, and some of the blast furnaces may be seen in the distance on the left of this photograph. The buildings on the right contain the plant for the recovery of the bye-products from the gas, of which some particulars are given later.

The cake of compressed coal takes about 24 hours to coke. This process being completed, the door on the discharge side of the particular oven is raised by means of an electrically-operated travelling hoist which runs along a rail track on the top of the ovens.

At the same time one of the two ramming machines, which run on the same rails as the charging machines, is brought up to the other side of the oven, and the hinged door on that side being opened, the charge of coke is forced out—through an enclosed coke quencher suspended from the hoist—on to an iron-plated sloping hearth at the back of the ovens. The coke-quencher, which may be seen in fig. 1, is virtually a species of shower bath apparatus which hangs in front of the oven orifice, and which distributes a copious supply of water over the red-hot coke as it emerges from the oven. The sloping hearth on to which the coke drops may be seen in fig. 1, and a charge of coke will be noticed thereon. The coke is drawn off the hearth into barrows as required and wheeled across to the blast furnace hoists.

Fig. 7 gives a good view of one of the rams, this being equipped with two motors, one for travelling and the other for working the ram. The latter motion is effected through reducing and clutch gear, and a pinion which engages with a long steel rack with 3 in. pitch shrouded teeth; this rack is bolted to the top of a strong built-up girder, which carries the ram head at one end. The ram head, the girder, and the rack may be seen in figs. 5 and 7.

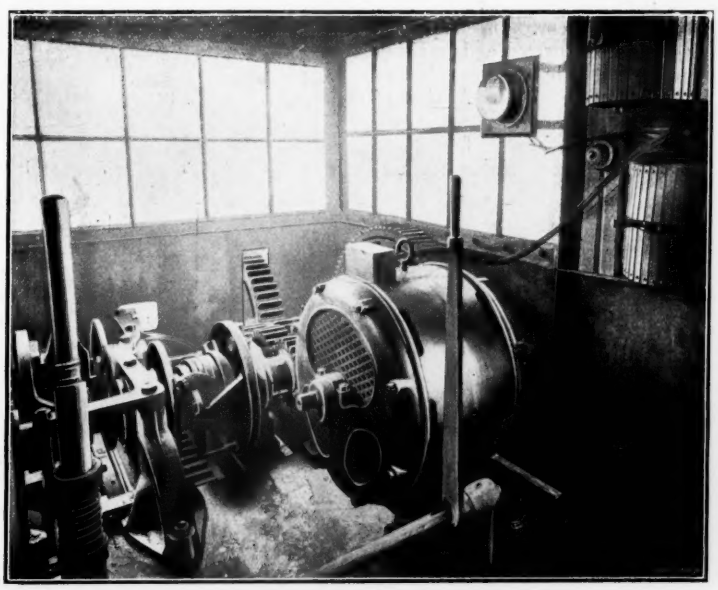


FIG. 6.—OPERATING CABIN: COKE-OVEN RAM.

The pushing head or ram is of cast-iron, this being found more suitable than steel, and it is protected by a complete sheathing of ⅜ in. steel plates. All the bearings have unusually ample surfaces, with gun-metal steps and white metal linings.

The travelling motor is a variable speed machine, so that the centring of the ram with regard to the oven is thus facilitated. The speed of the travel along the rails is the same as in the case of the charging machines, viz., 300 ft. per minute. The racking motion operating the ram has a slow pushing speed, which is adjusted to suit the time required for the quenching of the coke; and a return speed five times as great, the reverse motion being obtained by coil type friction clutches without stopping or reversing the motor. The clutch on the first motion shaft engages for

the quick return motion, and that on the second motion shaft for the slow-pushing motion ; both are controlled by

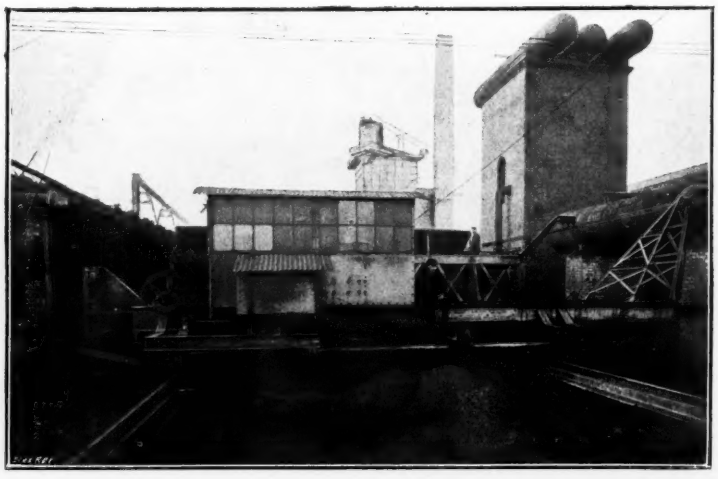


Fig. 7.—Electrically-Driven Coke-Oven Ram.

one lever, and as the motor runs in one direction only, the controlling operations are of the simplest character. In the case both of the charging machines and rams, the gearing is of steel throughout. Fig. 5 is a plan and elevation of the coke-oven ram, and fig. 6 depicts the interior of the operator's cabin on one of the rams, the motor and gearing just described, being housed therein. This figure gives a good view of one of the coil clutches, as well as part of the other ; the reducing gear and operating lever are also shown. An important point concerning the arrangement of the motor control gear on both the chargers and the rams, is that it is impossible for both motors to be set in motion at the same time.

Fig. 8 shows the pump-room, where the water for coke-quenching, gas cleaning, and steam-condensing purposes is pumped up to a tank overhead. There are two pumping sets in this room, each consisting of a motor direct-coupled to a Gwynne centrifugal pump.

The gases given off in the process of coking are withdrawn by means of exhausters, and after being passed through a series of condensers, tar extractors, and scrubbers, are returned to heat the side flues of the ovens. In this process the tar and ammonia in the gases are recovered, and provision is made for the extraction of the light oils, though this latter process is not at present carried out. A view of the exhausters is given in fig. 9.

Besides the gas which is used to heat the oven flues, there is a surplus—amounting to about one-third of the whole—

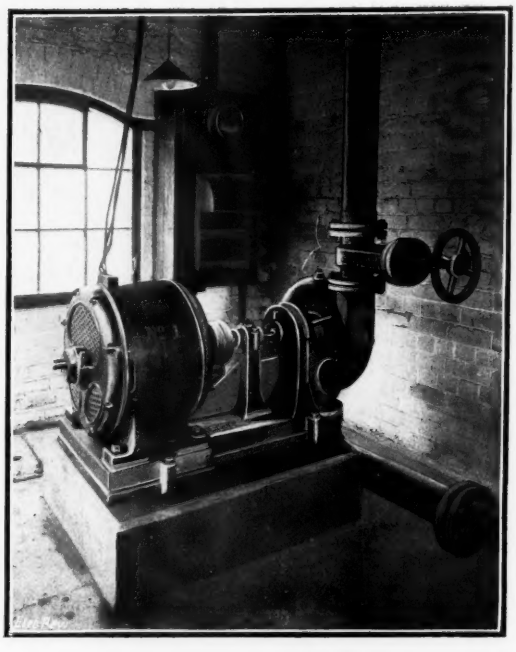


Fig 8.—View in Pump Room.

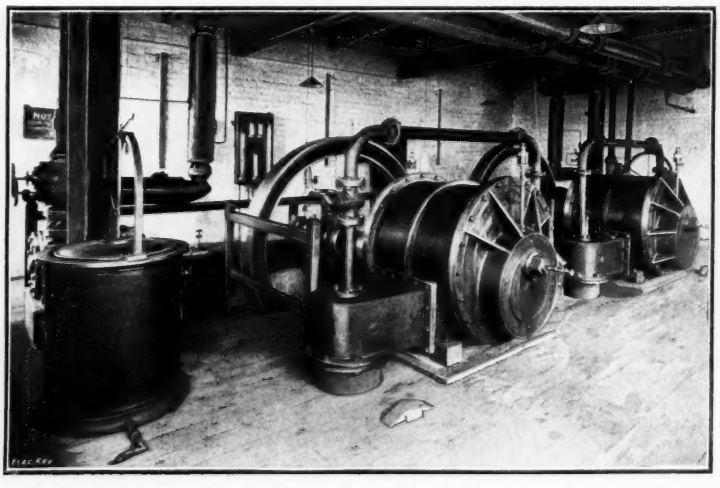


Fig. 9.—Gas Exhausting Plant.

which at present is used to reinforce the waste heat for boiler firing, steam at 120 lb. pressure being utilised for the service of the plant. The primary object of the plant which has been described, is the production of the maximum yield of the high-class, bright, hard and dry coke which is so essential to obtaining the best work from blast furnaces; this object has been fulfilled to the entire satisfaction of the company by the Semet-Solvay system installed. The grinding and compression of the coal before it is introduced into the ovens has much to do with the good results obtained, and the quenching of the coke, as it leaves the ovens, prevents blackening of the surface ; finally, when the coke lies on the sloping hearth all surplus drenching water is rapidly drained off, and the coke is left bright and dry. Other important points are the rapidity of the process as compared with the older methods, and the income derivable from the sale of the bye-products, which were formerly wasted.

The bye-products obtained during the process of coke manufacture are tar, ammoniacal liquor, light oil and gas. The tar is sold to distillers. The ammoniacal liquor is worked up into sulphate of ammonia, a most valuable bye-product, the plant for this purpose being adjacent to the coking plant. The light oil, which is used for manufacture into benzols, solvent naphtha, &c., is not at present recovered. The surplus gas, after purification, is available for illuminating purposes or for other requirements.

The electrical installation is of special interest, in that three-phase instead of direct currents are employed. Considering the conditions under which the plant is worked and the fact that it has been running day and night continuously, the results are very favourable to the polyphase system, in connection with which the British Westinghouse Electric and Manufacturing Co., Ltd., are to be congratulated.

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page 770.*)

Portsmouth Municipal Telephones.—On Tuesday Mr. Ross Hooper, Local Government Board Inspector, held an inquiry into the application of the Corporation for permission to borrow £28,835 for the purpose of extending the municipal telephone system in the borough and contiguous district. Mr. Hammond Etherton, deputy town clerk, informed the Inspector that the system had been working since March 1st, 1903, and the first year's profit was £1,233 8s. 10d., whilst last year the profit on the year's working was £1,969 9s. 8d., of which £614 had been paid over to the suspense account. The Inspector questioned Mr. Etherton as to the work which the L.G.B. had refused to sanction, and elicited that it had been carried out, the Council having itself raised a loan. The Inspector asked by what authority the money was borrowed, and from whom it was obtained. Mr. Etherton replied that there was no express authority except the licence to carry on telephone business. The money was obtained from the Finance Committee. The Inspector said that this was outside the question altogether. How could the net revenue account be created when the Council had raised money without any power whatever, and the whole of the profits were more than swallowed up by the debts incurred without any powers? Mr. A. R. Bennett, consulting engineer to the Corporation, was among the witnesses called in support of the application, which was opposed by Mr. Robb, solicitor, of Tunbridge Wells, and Mr. R. H. Wadeson on behalf of a local Property Owners' Protection Association.

The Telephone Transfer.—Replying to Sir John Leng, Lord Stanley recently said he was aware of the provisions in the Telegraph Act of 1868 dealing with the transfer of the staffs of the various telegraph companies to the Post Office. He was not prepared to propose similar arrangements as regards the staff of the National Telephone Co., since he believed that to follow that precedent in the present instance would impose an inequitable burden on the taxpayers of the United Kingdom.

Telegraphic Interruptions and Repairs:—

	Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1)		Aug. 26, 1901	..
Dominica-Martinique		May 7, 1903	..
St. Lucia-Martinique		May 7, 1903	..
Cayenne-Pinheiro		Aug. 13, 1903	..
Reissa-Issa (Yemen)		Oct. 23, 1903	..
Tarifa-Tangier		Jan. 18, 1904	..
Closed { Vladivostok-Nagasaki		Feb. 9, 1904	..
Closed { Port Arthur-Chifu		Mar. 9, 1204	..
Jamaica-Colon		Jan. 5, 1905	..
Martinique-Paramaribo		April 2, 1905	May 8
Maranham-Ceara		April 6, 1905	May 4
Bathurst-Bissao		April 22, 1905	..
Cape Haite-Mole St. Nicholas		April 28, 1905	..
San Domingo-Curacao		May 5, 1905	..
	Landlines.		
Puerto-Barrios		July 28, 1902	..
Kertch-Soutchoum		Sept. 27, 1904	..
Pekin-Kiachta		May 5, 1905	May 5

Telegraph Time Signal.—During the International Railway Congress at Washington last week, a telegraph time signal was dispatched round the world. One report says that the time occupied was seven seconds, but this, of course, is an impossibility. Arrangements were made with the British Government and the various telegraph companies to have their lines clear at a time agreed upon, with the result that almost simultaneously with the opening of the switch at Washington the fact was signalled in a dozen of the principal cities in Europe—London, Paris, Berne, Budapest, Hamburg, Rome, Vienna, Belgrade, Bucharest, Sofia, Brussels and Amsterdam.

Wireless Telegraph Libel Action.—In July of last year the De Forest Wireless Telegraph Co. brought an action for libel against the Marconi Wireless Telegraph Co., of America, in the United States Circuit Court of the Southern District of New York, fixing damages at $1,000,000. The alleged libel was stated to be comprised in a communication, said to have been made by the manager of the Marconi Wireless Telegraph Co., of America, in connection with a certain contract with the United States Government entered into by the De Forest Co. On April 24th last counsel for the De Forest Co. applied for an order for the discontinuance of the action in question, upon the calling of the calendar of the United States Circuit Court of the Southern District of New York, and the costs of the Marconi Wireless Telegraph Co., of America, have been ordered by the Court to be paid by the De Forest Co.—*Financial News.*

CONTRACTS OPEN AND CLOSED.

OPEN.

Ashton-under-Lyne.—May 23rd. Six single-deck tramcars. See "Official Notices" May 5th.

Bangour Village.—May 27th. Edinburgh District Lunacy Board wants offers for boilers, engines and dynamos, economisers, cranes, battery, switchboard, cables. Electrical engineers, Messrs. Buchan and Hogarth, 16, Rutland Square, Edinburgh. Architect, Mr. H. J. Blanc, 25, Rutland Square, Edinburgh.

Brussels.—May 16th. The City Authorities invite tenders for electric cables and accessories. Specifications (1 fr. 50) at Rue Sainte-Catherine, 11, Brussels. Tenders to the College des Bourgmestre et Echevins.

Clydebank.—May 22nd. Electric arc light installation for the Outer Basin of Clydebank Dock. Mr. Geo. H. Baxter, mechanical engineer, Clyde Navigation, 16, Robertson Street, Glasgow.

Darlington.—May 23rd. Two storage batteries for the electricity works. See "Official Notices" to-day.

Dartford.—May 24th. Lancashire boiler, piping, one 200-kw. steam dynamo, traction battery and reversible booster, main switchboards, &c., for the U.D.C. light railways. See "Official Notices" May 5th.

Dublin.—May 15th. The Dublin Port and Docks Board is prepared to receive tenders for an electric generating station. Apply to Mr. John P. Griffith, M.Inst.C.E., East Wall, Dublin, for specifications &c., (deposit £5).

Dublin.—May 30th. The Cleansing Committee wants tenders for tank wagons, covered tipping wagons, &c., for conveying city refuse over the tramway routes. City engineer, Mr. Spencer Harty, City Hall.

Edinburgh.—May 30th. Switchboard panel extension for McDonald Road station. See "Official Notices" to-day.

France.—May 14th. Tenders are being invited until May 14th, by the municipal authorities of Dax (Landes) for the concession for the electric lighting of the town during a period of 35 years. Tenders are to be sent to La Mairie de Dax (Landes), whence particulars can be obtained.

France.—May 15th. The Governor General of French West Africa, at Dakar (Senegal), is inviting tenders for the establishment of a central electricity station in the town, and for the construction of an electric tramway.

Heywood.—May 17th. Lancashire boiler, two 200-kw. steam dynamos, traction switchboard and feeders, and other plant for electricity works extensions. See "Official Notices" May 5th.

Islington.—May 24th. Coal bunkers for the electricity works. See "Official Notices" May 5th.

Keighley.—May 20th. Superheaters. See "Official Notices" May 5th.

Kettering.—May 29th. Nernst lamps, posts, &c., for street lighting. See "Official Notices" May 5th.

Leith.—May 17th. Coal elevating and conveying plant, and boiler-house auxiliary plant. See "Official Notices" May 5th.

Llandudno.—May 22nd. Switchboard extensions, also two balancing sets for the U.D.C. See "Official Notices" to-day.

London.—May 16th. The L.C.C. invites tenders for the erection and maintenance, for a period of 10 years, of a battery of 280 accumulator cells, having capacities of 645 ampere-hours at a 3-hour discharge rate, and of 450 ampere-hours at a 1-hour discharge rate. See "Official Notices" April 21st.

Maidstone.—May 15th. Electric light installation for the Sessions House. County Architect, 86, Week Street, Maidstone.

Melbourne.—July 14th. Arc lamps, poles, brackets, &c., for street lighting for the Council. See "Official Notices" to-day.

Paisley.—May 13th. Electric power generating plant (gas engines and dynamos), electric coke conveyors, electric screening plant, &c., for the Gas Corporation (Mr. G. R. Hislop, engineer and manager).

St. Pancras.—May 23rd. Arc lamp carbons for one year. See "Official Notices" to-day.

Sunderland.—May 24th. Tramway stores. See "Official Notices" May 5th.

Warrington.—May 13th. Condensing plant for the electricity works. See "Official Notices" April 28th.

CLOSED.

Barking.—Messrs. Johnson & Phillips have recently received orders for a 400-kw. traction generator and switchboard extension for the Barking Urban District Council; also for 150 and 50-kw. generators for Dye Works.

Battersea.—The B.C. has placed an order with Messrs. Babcock & Wilcox, Ltd., at £480, for superheaters on the three new boilers.

Barrow.—Messrs. Chamberlain & Hookham's tender for meters has been accepted by the Corporation; also that of Messrs. Alexander Duckham & Co., for insulating compound for the ensuing year.

Bournemouth.—The T.C. on May 3rd accepted the following tenders in connection with the Christchurch tramway extension:—

British Electric Equipment Co., Ltd., steel poles, overhead equipment, section boxes, &c., £4,315.

Messrs. Johnson & Phillips, feeder cables, troughing, junction boxes, &c., £5,405 16s. 5d.

British Westinghouse Co., tramcars, £6,522.

Buenos Ayres.—Messrs. J. G. White & Co., Ltd., have just closed a contract for the construction of the Rural Tramways here. The work comprises supply and erection of 35 miles of overhead equipment; supplying and laying the necessary cables; the supply of about 100 cars and equipments; and the erection and equipment of a power house with 2,000 KW. The amount of the contract is approximately £250,000. Work will be begun next autumn.

Burnley.—The T.C. has accepted the tender of Hadfield's Steel Foundry Co., Ltd., for a tram rail grinder, at £105.

Cardiff.—The Corporation E.L. Committee has accepted the tender of the General Electric Co, Ltd., of London, for four motor-generator sets, at £4,956 18s.

Cumberland.—The tender of Messrs. Wylie & Lochhead, Ltd., of Glasgow, has been accepted for the installation of the electric light at Garlands Asylum, Cumberland.

Durham County.—The C.C. has accepted the tender of Messrs. C. A. Parsons & Co., Ltd., for electric plant to the County Asylum, at £5,143 13s. 9d.

East Ham.—The T.C. has accepted the tender of Messrs. E. Foster & Co. to supply to the generating station for the period ending March 31st next, Mardy Welsh coal, at 15s. 9d. per ton.

Erith.—The following were the five lowest tenders received by the U.D.C. for wiring the car depôt and workshops for electric lighting and power:—

Clements, Booker & Co., Westminster (withdrawn) ..	£164 10
W. Dickinson & Co., Bexley Heath (accepted).. ..	200 0
J. E. Collum & Co.	206 15
A. H. Marshall & Co., Leytonstone	215 10
Owen's Ironmongery Stores, Ltd., Erith	221 18

For pipework at the electricity station the following tenders were received and referred to the Committee and the consulting engineers:—

T. Sugden, Ltd., London	£513 0 0
John Spencer, Ltd., Wednesbury	452 12 6
T. Piggott & Co.	504 0 0
Yates & Thom, Blackburn	724 0 0
Babcock & Wilcox, Ltd.	492 0 0

Glasgow.—The Tramways Committee has recommended for acceptance the following offers:—

Switchgear for sub-stations, the Westinghouse Co.
Testing instruments for power station, Messrs. Elliott Bros.

Godalming.—The T.C. has accepted the tender of the National Telephone Co., for the provision of street fire alarms.

Govan.—The tender of the Lancashire Dynamo and Motor Co., Ltd., has been accepted for the supply of motors for all sizes above 3 H.P. This is the third year that this company has had the contract.

Greenock.—The Corporation has accepted the tender of the British Westinghouse Co. for one 400-KW. steam generator, at £2,900.

Horsham.—The U.D.C. has accepted the tender of the British Westinghouse Co. for a steam balancer set for the E.L. station, at £1,018 10s.

Manchester.—The Corporation has placed an order with Messrs. Ferranti, Ltd., for continuous current switchgear for the Dickinson Street generating station.

Marylebone.—The B.C. Electric Supply Committee has provisionally accepted the tender of Messrs. Chamberlain & Hookham for 5,525 two-wire meters, at £8,588 15s., and 110 three-wire meters, at £456 5s. Tenders were also received from the following firms, but the prices were not disclosed:—Messrs. Rumney and Rumney; Ferranti, Ltd.; Reason Manufacturing Co.; British Thomson-Houston Electrical Co.; and the General Electric Co. The same Committee has provisionally accepted the following tenders for annual supplies:—Small cables, estimated value of contract £400, St. Helens Cable Co., Ltd.; steel conduits, estimated value of contract £100, Simplex Steel Conduit Co., Ltd.

Newport (Mon.).—The tender of Messrs. Callender's Cable & Construction Co. for electrical cables has been accepted at prices ranging from £49 to £625, for concentric cables per 1,000 yds.; £67 to £673, concentric armoured ditto; £137 to £692, triple-concentric ditto; and £166 to £750, triple-concentric armoured ditto.

Keighley.—The following is a list of tenders submitted for a 300-KW. set for the Electricity Works:—

	Tender.	Alternative.	Delivery.
Thos. Parker, Ltd., Wolverhampton	£1,712 Allen	£1,444 Browett	20 weeks
Electric Construction Co., Wolverhampton	1,840 „	1,580 „	21 „
International Electrical Engineering Co.	1,740 „	1,472 „	5 months
James Howden & Co., Glasgow ..	1,706 Parkers-Howden	1,874 Crompton-Howden	19 & 21 weeks
Armstrong, Whitworth & Co., Ltd...	2,006 Allen		
J. H. Holmes & Co.	2,060 „	2,580 Belliss	4 months
Phœnix Dynamo Manufacturing Co., Bradford	1,696 „	1,420 Browett	21 weeks
Browett, Lindley & Co., Ltd. ..	1,474 Mather and Platt-Browett	1,495 Parker-Browett	18 „
British Westinghouse Co., Ltd. ..	1,681 Allen	1,598 „	18 „
Mather & Platt, Ltd.	1,725 „	1,430 „	5 months
J. & E. Wood, Bolton	8,125 Wood	—	
Greenwood & Batley, Ltd.	1,786 Allen	1,540 „	20 weeks
The Lancashire Dynamo & Motor Co., Ltd.	1,879 „	1,551 „	4 months
Dick, Kerr & Co., Ltd.	1,961 „	—	5 „
Davey, Paxman & Co., Ltd.	1,936 Davey-Paxman	—	4 „
British Electric Plant Co., Alloa, N.B.	1,897 Allen	1,629 „	4 „
Siemens Bros. & Co., Ltd.	1,780 „	1,720 Belliss	22 weeks
British Thomson-Houston Co. ..	1,965 „	1,681 Browett	22 „
Bruce Peebles & Co., Ltd.	1,822 „	1,540 „	—
J. Musgrave & Sons, Ltd.	1,997 Musgrave	—	16 weeks
J. Fowler & Co. (Leeds), Ltd. ..	1,778 Allen	1,507 „	4 months
Royce, Ltd.	2,326 Willans	—	5 „
Galloways, Ltd.	1,845 Galloway Phœnix	1,870 Galloway Parker	18 weeks
Vickers, Sons & Maxim, Ltd... ..	1,844 Allen	1,570 Browett	17½ „
The General Electric Co., Ltd. ..	1,868 „	1,586 „	17 „
Johnson & Phillips	1,756 „	2,290 Belliss	22 „
Crompton & Co., Ltd.	1,876 „	1,613 Browett	24 „
The Brush Electrical Engineering Co., Ltd.	1,850 Brush	—	18 „
The Electrical Co., Ltd.	1,844 Allen	2,178 Belliss	4 months
C. A. Parsons & Co.	2,128 Parsons	1,562 Browett	5½ „
The India-Rubber Co., Ltd.	1,896 Allen	1,687 „	20 weeks

Portsmouth.—The T.C. has accepted a tender from the International Electric Co., for refitting the telephone switchboard with 150 indicators, 24 pairs of cords and plugs, 24 ring-off coils and operators' keys, &c., at £75 net; also the tender of the Ericsson Bell Telephone Co., for 100 wall instruments and 25 table instruments. The following tenders were received:—The Ericsson Bell Telephone Co., for wall and table instruments, £2 5s. each; W. F. Dennis & Co., for wall instruments only, £2 5s. each; the International Electric Co., for wall instruments, £2 6s. 6d. each; for table instruments, £2 9s. 6d. each.

Southampton.—The Tramways Committee has accepted the tender of Messrs. Griffiths & Co., of London, for re-laying the Portswood Road section of the tramway, at £1,711.

South Shields.—The T.C. has accepted the tender of Messrs. Hurst, Nelson & Co., Ltd., for 10 tramcars with Brill trucks (British make), at £5,307.

Tramway Contracts.—We learn that the National Electric Construction Co., Ltd., has secured the tramway contract for Mexborough, Rawmarsh and Swinton. The contract includes the generating station building, car-sheds, generating plant, cars, permanent way and cables; also feeders and distributors for lighting Swinton and Rawmarsh. The same company has also secured the contract for the laying of permanent way, feeders and cars for the Torquay Tramways. The total amount in all is appoximately £300,000. The former contract will be started within four weeks' time, while operations will commence on the latter during August next.

West Ham.—The Corporation has placed an order with Messrs. S. Dixon & Son, Ltd., for 10 additional installations of Turner's tramway point controllers at £88 each.

Wigan.—The E.L. and Tramways Committee has accepted the tender of Messrs. Dick, Kerr & Co., Ltd., for the supply of an engine and dynamo, and those of Messrs. Johnson and Phillips and the British Insulated & Helsby Cables, Ltd., for cables.

FORTHCOMING EVENTS.

To-day's Arrangements.—At 9 p.m. Royal Institution. Prof. Ernest F. Nichols, of Columbia University, N.Y., on "The Pressure Due to Radiation."

At 8 p.m. Physical Society. (1) "A Simple Method of Determining the Radiation Constant: Suitable for Laboratory Experiment," by Dr. A. D. Denning. (2) "A Bolometer for the Absolute Measurement of Radiation," by Prof. H. L. Callendar. (3) "The Resistance of a Conductor the Measure of the Current Flowing Through it," by Mr. W. A. Price.

Saturday, May 13th.—Junior Institution of Engineers. Visit to the Dorking Water, Gas and Electricity Works. Train leaves Cannon Street at 1.30 p.m.

At 7.30 p.m. Birmingham and District Electric Club. Mr. J. A. Jeckell on "Cheap Electrical Energy for Power Purposes."

Monday, May 15th.—At 8 p.m. Society of Arts. Cantor Lecture. Mr. H. W. Ravenshaw on "The Use of Electricity in Mines." Lecture I.

Wednesday, May 17th.—At 5.30 p.m. Chemical Society Meeting.

At 7.30 p.m. I.E.E. (Students). "Manufacture and Design of Electric Power Cables," by Mr. A. L. Kavanagh.

Thursday, May 18th.—At 5 p.m. Royal Institution. Prof. Sir James Dewar, on "Flame." Lecture III.

At 8 p.m. Faraday Society. Dr. T. M. Lowry on "An Application to Electrolytes of the Hydrate Theory of Solutions."

Friday, May 19th.—At 7.30 p.m. N.E. Coast Institution of Engineers and Shipbuilders. Closing Business Meeting. Mr. J. F. C. Snell will reply to discussion on "Applications of Electricity to Industrial Purposes."

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders have been issued for next week:—

Monday, May 15th.—"A" Company. Drill Order Parade at 7 p.m. Technical Instruction, 8 p.m.

Tuesday, May 16th.—"B" Company. Instructional Drill, 7 p.m. Technical Instruction, 8 p.m. Medical Inspection for Recruits and Special Service Section, 7 p.m.

Wednesday, May 17th.—Adjutant's Drill at Millbank Barracks. Parade at Headquarters, 7.30 p.m. Drill order. Blue. Examination "C" and "D" Companies for "A" Badge, 7 p.m.

Thursday, May 18th.—"C" Company. Technical Instruction, 6 p.m. Company Drill, Parade at Headquarters, 7.30 p.m. Rifles and side arms. Plain clothes.

Friday, May 19th.—"D" Company. Recruits' Drill, 6.30 p.m. Drill Order Parade for whole of Company, 7 p.m. Blue if possible. Technical Instruction afterwards.

Saturday, May 20th.—"A" Company Supper at Headquarters, 7.15 p.m. for 7.30.

WILFRID C. DUMBLE, Captain R.E.
For O.C.E.E.R.E. (V.)

NOTES.

Gas Engines and Storage Batteries.—Mr. Archibald's conclusions relative to the economy of steam and gas engines with different load factors, to which we referred in our last issue, should serve to direct particular attention to the secondary battery. It has long been realised that if a battery of accumulator cells could be secured that would last indefinitely, or even for several years, the economy to be secured in the way of capital cost of power generating plant and in the consumption of fuel would be beyond anything that can be obtained in other directions, such as condensing or mechanical stokers. If Mr. Archibald's conclusions are correct, it follows that the gas engine would benefit more than the steam engine by the use of an accumulator for the provision of an engine load factor of 100 per cent. The load factor would be kept at that value by running the engine up to its maximum power, and shutting down when the cells were fully charged. The engine would be run when required, and always at full load. When not actively at work, the stand-by losses of a steam boiler are considerable. The stand-by loss of a gas producer, on the other hand, is not great, for a producer will remain quiescent with its fuel contents incandescent for quite long periods, and it will speedily pick up again. What the suction gas producer requires to enable it to meet a varying demand for gas is the addition of an over-weighted suction holder governor between the engine and the producer. Such a holder would rise when the engine stopped, and would accumulate a store of gas to be drawn upon when the engine started again, thus providing gas while the producer was becoming drawn gradually up to full productive output.

England's "Home of Mystery."—We recently had the pleasure of visiting Messrs. Maskelyne's new entertainment at St. George's Hall, Langham Place, W., and of being agreeably mystified by the marvellous feats of magic and mystery for which the firm is renowned. Every item on the programme is well worth seeing, and in the case of the illusions presented, it is impossible to detect the mode in which they are accomplished. The most striking feature of the latter is the apparent ease with which they are performed; doubtless success depends very largely upon the precision with which each process is carried out, and the accuracy of timing on the part of the various performers, but there was not the slightest hitch in any one of them.

Naturally, electricity plays an important though unobtrusive part in the performances, and a very elaborate equipment has been designed and installed for this purpose by Mr. Edward Morehen, electrical engineer to the firm. The maximum lighting load amounts to more than 50 KW. for the stage alone, which is equipped with over 1,000 lamps, mainly fixed in battens and floats. The switchboard, which is situated on a special gallery within sight of the stage, consists of two sections containing in all 60 circuits. Ten of these are controlled on a small board arranged on the three-wire system, with 200 volts across the outers, and are used for feeding outdoor arc lamps, auditorium lighting, &c. The main board comprises a large panel fitted with 13 sets of four switches, which are respectively a master switch, and three circuit switches for red, white and blue lamps, or other colours, controlled by the master switch. The four switches are vertically in line, and above them in the same line are the corresponding fuses and pilot lamps. A separate panel carries switches connected with a number of special circuits, and heavy double-pole main switches at the end of the board cut off the whole when desired.

The dimming resistances, which are of the Wirt ironclad type, are mounted in a room under the stage, and are operated by means of rods and bevel gear; they can be regulated separately or *en bloc*, or in any combination, by means of hand-wheels and clutches on the switchboard gallery. Special arrangements have been adopted for the stage lighting, whereby greatly improved effects have been obtained; the auditorium and corridors, in accordance with the regulations of the L.C.C., are supplied with electricity from two entirely separate sources, and the lamps are so arranged that the failure of either supply would cut off only alternate groups of lamps. The wiring throughout is in steel screwed unlined tubing, supplied by the Conduit and Insulation Co., and the whole of the work has been carried out with every precaution against risk of fire or breakdown. The mysterious and weird mechanical arrangements which we noticed in the depths beneath the stage baffle description, and as we don't know what they were for, we won't give the show away.

Standardisation of Fuses.—We are pleased to learn from Mr. Leslie S. Robertson, secretary to the Engineering Standards Committee, that the importance of this question, to which we referred in our leading columns last week, has not escaped the attention of the Committee. The subject is to be dealt with by the Sub-committee on Electrical Plant Accessories, of which Mr. C. H. Wordingham (representing the Admiralty) is chairman.

The other members of the Sub-committee are:—

Mr. L. J. Steele,	Representing the Admiralty.	
Col. H. C. L. Holden, R.A.,	"	War Office.
Mr. A. P. Trotter,	"	Board of Trade.
Mr. G. Scott Ram,	"	Home Office.
Mr. A. H. Preece,	"	Crown Agents for the Colonies.
Dr. R. T. Glazebrook,	"	National Physical Laboratory.
Mr. T. P. Wilmshurst,	Nominated by the Incorporated Municipal Electrical Association.	
Mr. F. H. Nalder. / Mr. C. S. Northcote.	Nominated by the Electrical Manufacturers' Association.	
Mr. J. H. Rider.	Mr. T. L. Miller.	
Col. R. E. Crompton, C.B.	Mr. W. H. Miller.	
Mr. W. A. Chamen.	Mr. J. Rennie.	
Mr. G. B. Elphinstone.	Mr. Lester Taylor.	
Mr. S. Evershed.	Mr. John F. C. Snell.	
Mr. J. S. Highfield.	Mr. C. P. Sparks.	
Mr. L. Langridge.	Mr. W. H. Patchell.	

Mr. Leslie S. Robertson, M.I.C.E., Secretary.
Mr. C. Le Maistre, A.M.I.E.E., Electrical Assistant Secretary.

Having regard to the very wide field covered by the title "Electrical Plant Accessories," it is to be hoped that the subject of fuses may be singled out for special attention, in order that it may be placed once for all on a satisfactory basis.

Football.—The Arc Works Club (Crompton & Co., Ltd., Chelmsford), has had a very successful football season. The result is as follows:—

The First Eleven are champions of the Chelmsford and District League, having won the Cup and Medals. The Reserve Team are champions of the Second Division of the Chelmsford and District League, and they also receive Medals. The First Eleven are joint holders with Halstead in the North Essex League. The result of the matches played during the season is as under:—

	Played.	Won.	Lost.	Drawn.	Goals for.	Against.
Arc Works 1st	25	20	3	2	118	39
" 2nd	17	12	2	3	54	23

Mr. H. C. Hawkins is the Club's hon. secretary.

Firemen and Electric Shocks.—The London Fire Brigade authorities have now decided that india-rubber gloves shall be carried with the fire escapes and fire engines. The firemen most frequently meet with electric wires and electric plant in the basements of houses.

Durham Collieries.—The Durham Collieries Electric Power Co. is to supply power to the Hetton Coal Co. The power is to be used for hauling, pumping, coal cutting, and lighting at the company's extensive collieries at Eppleton, Lyons and Elemore.

Accident.—An employé of the Rochdale electrical department was at work at a section box on 2nd inst., when an explosion occurred, and threw him into the middle of the road. He was badly burnt, and otherwise severely injured about the head.

The London Traffic Commission.—We read in the *Times* that further sittings of this Commision took place last week, when evidence regarding motor-omnibuses in the Metropolis was given, also evidence relating to the working of electric tramways at Liverpool and Manchester by Messrs. Bellamy and McElroy respectively. It is stated that this is the last of the evidence, and that by Whitsuntide the report will be presented.

Train Lighting.—Among the papers read at the International Railway Congress at Washington on Monday, was one by Superintendent Canovias, of the Hungarian State Railways, who expressed the opinion that the best illuminant for railway carriages was electricity.

Institution Notes and Lectures.—The progress made by Continental steel manufacturers in the use of the electric furnace was described by Mr. R. S. Hutton, of the Manchester University, at a recent meeting of the Manchester Section of the Society of Chemical Industry. One important branch of the industry, Mr. Hutton said, is likely to be revolutionised. As the new methods aim chiefly at the production of high quality crucible tool steels, in which our own country has always excelled, it is reassuring to find that the revolutionary processes are not of such a nature as to be unsuited for application here. As already mentioned in our columns, valuable reports have been published by the Canadian Government Commission sent out specially to investigate and criticise the electrical processes of manufacturing steel. The essential novelty of these new methods lies in the substitution of electric heating for the gas or coke firing, which has up to the present been employed in the various stages of treatment which iron has to pass through in the course of its transformation into steel. As a direct result of the application of the electric furnace, it has been found possible to turn out steel of a quality at least equal to that of the best Sheffield crucible steels, starting with far less costly materials than those at present utilised. The cause of this possibility lies in

the fact that the electric furnace enables the refining of a poor-grade steel to be carried to such a high point as to produce a metal of crucible steel grade. This is particularly noticeable in the ease with which phosphorus and sulphur—which are so injurious to the quality of steel—can be eliminated. In present-day practice the crucible steel manufacturer has to select his raw materials most carefully, and so mix them that, after fusion in the crucible, they shall have the desired chemical composition and accompanying mechanical properties. On the other hand, the Bessemer and open hearth processes, which are so widely employed for steels of lower grades, do not admit of the refining of the metal up to the quality of a crucible steel. In the electrical processes it is always possible to heat some 4 tons of metal at a time, and there is no reason why very much larger furnaces should not be constructed as soon as the development shows sufficient promise. The cost of production in this country, so far as the higher-grade steels are concerned, will certainly be in favour of the new methods. The consumption of electrical energy ranges from 718 to 1,100 B. of T. units per ton, according to the kind of steel manufactured. The relative cost of this energy will be only a small fraction of that which is paid for electrical energy for lighting or power purposes. In such manufactures as this it is possible to work continuously night and day throughout the year; and under these circumstances electrical energy can be generated and sold at prices which are far below what is possible with the very intermittent load of motors or electric lighting. It seems quite probable that in the near future the electric furnace will be considered a necessary adjunct to many of our ordinary steel processes. In this connection it is likely, at first, to be used chiefly for finishing off the refining of an ordinary steel. It has been shown that, even in the present small plant, an ordinary Bessemer steel, if transferred in the molten condition to the electric furnace, can be brought up to the quality of a crucible steel for the expenditure of only 120 Board of Trade units per ton. The extra cost of this treatment will, in any case, be a mere fraction of the enhanced value of the product.

The ninth annual conference of the Association of Tramway and Light Railways Officials was held at the Grand Hotel, Bristol, on May 3rd, Mr. H. England, of Wakefield, presiding. Mr. Chas. Challenger, of the Bristol Tramways Co., welcomed the officials to the city. After several new members had been elected, the report and accounts for 1904 were adopted. The president and Mr. Conaty were appointed to confer with the Municipal Tramways Association and the Tramways and Light Railways Association, to consider the advisability of forming a united association for the kingdom. It was decided to accept an invitation from the Tramways and Light Railways Exhibition Committee to meet at the Electric Traction and Railways Exhibition at the Royal Agricultural Hall, London, from July 3rd to 14th. The Executive Committee was elected as follows:—Messrs. A. L. C. Fell (London), C. Conaty (Birmingham), A. R. Fearnley (Sheffield), H. Mozley (Burnley), A. H. Bannister (Norwich), H. Hartley (Darlaston), and R. W. Cramp (Birmingham). It was agreed to hold the next meeting in London. Mr. Sidney Smith read a paper on "The Bristol Tramways," and a short discussion followed. In the afternoon the members visited the Brislington depôt and the power house.

The annual general meeting of the Students' Section of the I.E.E. will be held at 92, Victoria Street, S.W., on Wednesday, May 24th, at 7.30 p.m., to receive the report for Session 1904-5, and for the election of the committee and officers for Session 1905-6. There are vacancies for three extra-collegiate representatives on the Committee, for which nominations are invited, and they should be submitted to the students' hon. secretary as early as possible.

Dr. W. G. Rhodes, M.I.E.E., is at present delivering a special course of lectures on "Electric Traction" at the Victoria University of Manchester.

The fifth annual report of the Glasgow Section of the I.E.E. shows that there were 19 members added, but 15 resignations, so that the net increase is only 4, making the total membership in all sections 211. The annual meeting of the Section was held on Tuesday. Great regret is expressed at the loss sustained by the Section in the removal of Mr. Chamen to London. It is pointed out that there are many qualified electrical engineers in the Glasgow district who have not yet joined the Section, though some of them attend the meetings. They are urged to join and maintain the numerical strength of the Section.

At Monday's meeting of the Royal Institution, Mr. W. R. Bousfield, K.C., M.P., and Prof. J. J. Thomson were elected members. The President has nominated the following vice-presidents for the ensuing year:—Sir William de W. Abney, K.C.B., Mr. Shelford Bidwell, the Right Hon. Lord Alverstone, G.C.M.G., Dr. Ludwig Mond, the Right. Hon. the Earl of Rosse, K.P., Sir Thomas H. Sanderson, G.C.B., Sir James Crichton-Browne (Treasurer), and Sir William Crookes (Hon. Secretary). The Right Hon. Lord Rayleigh, O.M., F.R.S., was elected Hon. Professor of Natural Philosophy, and Prof. J. J. Thomson, F.R.S., was elected Professor of Natural Philosophy.

Electrical Standardising Institution.—As a result of the recent Open Scholarship Examination held in April, the Examiners recommend the following awards:—

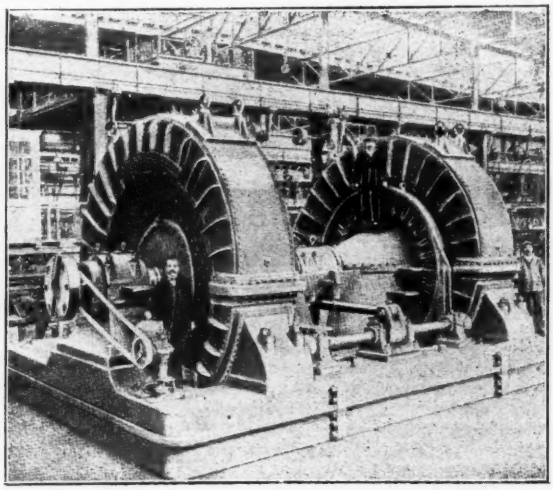
To Edward Stanton Ritter, of Cheltenham College, a Maxwell Scholarship of 50 guineas, tenable for two years.

To Louis Dudley Hooper, of Bournemouth School, and James Ardern Taylor, of Wellingborough Grammar School, Exhibitions value 30 guineas, tenable for two years.

The following candidates, who distinguished themselves in the above examination, have been awarded special prizes of 20 guineas each:—

Arthur Lionel Ballard, of Dunheved College.
Edgar James Barnes, of Bournemouth School.

Ontario Power Co., Niagara Falls.—We cull the following from the *Electrical World and Engineer*, New York:—A horizontal type turbine of the largest capacity ever built has been assembled in the power house of the Ontario Power Co., Niagara Falls. A view of the turbine as assembled in the shops of the manufacturer is reproduced herewith. The turbine stands 13 ft. in height above the floor, and the bed plates measure 21 ft. × 29 ft. It was designed and built by J. M. Voith, Heidenheim a. d. Brenz, Württemburg, Germany, and is the first of 20 to be installed for the development of 200,000 E H.P., each turbine driving a 10,000-H.P. generator. They are rated as follows:—11,340 H.P. 20 cb. metres (700 cb. ft.) per second, 187½ revolutions, when operated under a head of 53·4 metres (175 ft.) The turbines are of the inward-flow double Francis type, having two runners of 78 in. diameter, each capable of developing 5,700 H.P. The water is controlled at the turbine by swivel gates, which also act as guides. Lombard governors will be used. Relief valves are provided at the end of each penstock, discharging directly into the tail race. These enormous turbines are supplied by penstocks 9 ft. in diameter, which enter the power house below the floor level. Where each penstock enters the building, a heavy thrust flange is imbedded in the enormous mass of concrete which forms the foundation of the entire plant. The thrust of the water column equals 650,000 lb. for each turbine. The turbines are set above, to one side of, and with shafts parallel to, the penstocks, so that the supply pipes turn at an angle of 90° on the horizontal and 45° upward. The supply pipe ends in a spiral housing of heavily reinforced plates. The 175 ft. of head is made up of 155 ft. above the centre of the shaft and 20 ft. below. Since the water level of the river varies greatly on account of the narrowness of the gorge, the tail race is separated from the river by a weir, with a crest 7 ft. above normal river level. Both draught tube and tail race below the floor level are entirely of concrete. On account of the large and heavy pieces, special cars were necessary for transportation. The second turbine has been received, while the third has been shipped and the fourth is under construction.



11,390-H.P. Turbine, Ontario Power Co.

Diversity Factor.—The following letter came to hand from Mr. Taylor too late for inclusion with the discussion on his paper:—

"As this question of diversity factor is one of the greatest importance, and my extension of the ordinary meaning of load factor has evidently been misunderstood, I beg leave to further trespass on your columns.

"Mr. Tapper's remarks, and more especially, Mr. Arthur Wright's communicated remarks, bear out in a striking way my own deductions (p. 18 of paper). The Glasgow car motors, we are told, develop 60 kw. occasionally. Hence, taking a one-hour cycle, the energy consumption with a 100 per cent. 'load factor' (in the sense I have taken it) would be 60 units per car.

"But we know that for each unit consumed on the car, we ought to do a car-mile. Therefore, if the 'load factor' were 100 per cent, we should cover 60 miles in that hour. But it is found in practice that, including all stops, we only cover, say, 8 miles per hour = 8·0 units.

"Hence the load factor (over a 1-hour cycle) is only $\frac{8}{60} \times 100$ per cent. = 13·3 per cent. And the diversity factor is the reciprocal of the load factor, or $\frac{60}{8} = 7{\cdot}5$, which is almost exactly what Messrs. Wright and Tapper make it. Similarly, with very intermittent work, such as lifts, &c., the diversity factor may easily reach values of 10, 15, or even 20; but the load factor goes down in proportion.

"In spite of this, as I have shown in my paper, the station load factor, over the same cycle, may be quite high, because it is the product of the (cyclic) load factor and the diversity factor."

Parcel Traffic on Municipal Tramways.—It is stated that Messrs. Sutton & Co., the well-known parcel carriers, have commenced an action against the Manchester Corporation, asking for a declaration that the Corporation has not the power to use the tramways for the carriage of goods, nor to use the buildings, plant and servants of the department for other than tramway business. It is reported that Messrs. Sutton have obtained a writ from Mr. Justice Farwell, in the Chancery Division. The Tramway Committee will defend the action.

Appointments Vacant.—Temporary assistant engineer for the L.C.C. Asylums Committee (£200); assistant engineer for Napsbury Asylum, St. Albans (35s.); assistant electrical engineer for Oban (£70); mains superintendent (£150) for Coventry; shift engineer for Manchester (£150).

OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—Mr. W. A. CHAMEN was entertained to dinner in the Grosvenor Restaurant, Glasgow, on Thursday, 4th inst, by the members of the electrical profession in and around Glasgow on the occasion of his retirement from the chief engineership of the Corporation. Councillor D. M. Stevenson occupied the chair, and amongst those present were:—Mr. Mark Robinson, of Messrs. Willans & Robinson; Mr. J. Dalrymple, manager Glasgow Tramways; Mr. W. W. Lackie, Corporation electrical engineer; Mr. W. C. Martin, Mr. W. McWhirter, Mr. Sam Mavor (Messrs. Mavor & Coulson). The company numbered over 200 gentlemen. The chairman, in proposing the toast of the evening, referred to the occasion when Mr. Chamen was appointed chief engineer to the Corporation Electricity Department, and remarked that the gathering that night was the best possible tribute to his popularity. Mr. Chamen came to them as a man connected with a private firm, and he showed a capacity which amply justified his appointment. When he entered the service of the Corporation there were 150 people on the pay-sheet of the Electricity Department. Now there were 600. They had only one generating station then of 3,300 H.P.; to-day they had three stations with 19,000 H.P. The revenue in those days was £36,000 per year; it was now £180,000. If they took these figures, and if they took the audience that evening, they had a very substantial testimony to Mr. Chamen's work, and they had good reason to look back with pride to the fact that they selected a man more or less unknown in those days, who had proved far more capable than even they had hoped or expected. He was sorry to say there was a great deal of truth in the remark that the Corporation did not know the best way to keep a good man. It seemed to him the Corporation would act wisely if they asked, "What is this man's market value, rather than what is the amount we can screw him down to in dealing with him." He never knew a man in the Corporation service who got along so well as Mr. Chamen. He had managed to please the contractors, and he had managed to please the Corporation at the same time, a very difficult thing. He had also succeeded in pleasing the consumers, another difficult thing, and he was sure he went into private life with the best wishes of everyone. Mr. Thomas Wright, chairman of the Scottish Electrical Contractors' Association, also spoke to the toast touching on Mr. Chamen's administrative qualities. In reply, Mr. Chamen said it gave him the greatest pleasure to think that the Corporation had decided to appoint Mr. W. W. Lackie in his place, and Mr. Page chief assistant. A great deal of rubbish, he said, was talked in regard to Englishmen being unpopular in Scotland. He had never experienced anything but kindness in Scotland, and he knew nothing whatever about the so-called Scottish prejudice against Englishmen. He would always remember his seven years in Glasgow as one of the happiest chapters in his life.

Mr. A. N. MOORE, assistant resident engineer at Stuart Street station, Manchester, has been appointed superintendent of both the old and new generating stations at Belfast.

Mr. ERNEST DURHAM, who has been appointed second engineer at Bahia Blanca, under the South American Electric Light and Power Co., left England on Thursday, 11th, by the *Royal Mail*. The staff of the Wimbledon Borough Electric Light Works presented Mr. Durham with a kit bag, and gave him a hearty send off on resigning his berth amongst them.

Mr. PAULS, electrical engineer to the Middleton Corporation, was married at Southport on 3rd inst. to Miss Cissy Walker, daughter of Alderman Walker, ex-Mayor of Middleton.

Mr. A. PEDEN RUTHERFORD, burgh electrical engineer, Leith, is to be married on Tuesday, 30th inst.

Kingston-on-Thames T.C. on Tuesday increased the salary of the electrical engineer (Mr. J. E. EDGCOMB) by £100, bringing it up to £510 per annum.

General.—Mr. WILLIAM A. TOOKEY has commenced practice at 29, Old Queen Street, Westminster, S.W., as an expert on steam, gas, and oil engines, and power-producing machinery in general.

The Electric Lighting Committee of the Stepney B.C. reported on Monday that Mr. WRIGHT, the consulting electrical engineer, had informed them that he had decided to relinquish his intention of increasing his shareholding in the Reason Manufacturing Co, and of becoming a director thereof. The Council had been aware of Mr. Wright's connection with the company from the date of his first appointment, and he had never been consulted on the suitability of the apparatus purchased from the company, nor had he assisted in drawing up the specification. The present arrangement between Mr. Wright and the Council was preferable to a system of remuneration based upon percentage payments.

Mr. HILLIARD STEPHENS, A.M.I.E.E., A.M.I.M.E., of 39, Victoria Street, has been appointed sole London agent for the Asphaltic Limestone Concrete Co., Ltd., direct importers and refiners of Trinidad bitumen, for the sale of bitumen, box compounds, and asphalte. Mr. Stephens has also been appointed agent to Messrs. A. & J. Main & Co., Ltd., structural engineers, Glasgow and London. All communications should be addressed to 39, Victoria Street.

The Right Hon. Lord GEORGE HAMILTON, P.C., M.P, and Mr. WILLIAM H. BROWN, have been elected directors of the Metropolitan District Railway Co. Mr. CHARLES JAMES CATER-SCOTT (chairman of the London and India Docks Co.) has been elected a director and appointed chairman of the London United Tramways (1901), Ltd., Mr. CHARLES T. YERKES having resigned the chairmanship in order to enable him to devote more of his time to the Metropolitan District Railway Co. Mr. William H. Brown has also been elected a director of the London United Tramways Co.

On April 29th, at St. Margaret's Church, Lee, Mr. VALERI ALFRED FYNN was married to Alice, daughter of the late Richard Charles Studdert, M.D.

The *Burnley Gazette* says that Mr. WM. T. TAYLOR, A.M.I.E.E., has been elected assistant superintendent of a division of the California Electric Corporation. The Corporation operates about 800 miles of 45,000-volt transmission service, and shortly will increase the line voltage to 55,000. Mr. Taylor is at present located at Sacramento, California.

Mr. D. MARTIN, lately manager of the manufacturing department of the Electrical Trades Supply, Ltd., Birmingham, has been received into partnership with the engineering firm of Messrs. R. McFie & Sons, St. Mungo Works, Glasgow.

The Bureau International des Administrations Télégraphiques, Berne, announces that on August 1st next, by reason of ill-health and advanced age, Mr. EMILE ESCHBAECHER is retiring, after being with the Bureau for 20 years, he having spent more than 50 years in the telegraph service. He took part in the International Telegraph Conferences of London (1879), Berlin, Paris (1890), and Budapest and London (1903).

Obituary.—We regret to record the death of Sir ROBERT HERBERT, G.C.B, who will be remembered by electrical men chiefly by reason of his connection with the Telegraph Construction and Maintenance Co., of which he was the chairman, and with the Eastern and South African Telegraph Co., of which he was a director. Of his distinguished public career, space does not permit us to speak in detail. He was late permanent Under-Secretary of State for the Colonies. Late in 1903 Sir Robert became chairman of Mr. Chamberlain's Tariff Commission. He had suffered from heart trouble for some time, and went for a cruise in the Mediterranean, but feeling worse he hurried home, and arrived there in time to die. He reached Ickleton on Friday night at 8 o'clock, and passed away at 2 30 on the following morning. He was in his 74th year.

NEW COMPANIES REGISTERED.

Sir Hiram Maxim Electrical Co., Ltd. (84,426).—This company was registered on April 29th, with a capital of £50,000 in £1 shares (30,000 preference), to acquire from the Peddie Small Arms Corporation, Ltd., the business and property recently acquired by that company from Sir Hiram Maxim Electrical and Engineering Co., Ltd., to acquire any other concessions, rights or properties, and to carry on any business connected therewith. The first subscribers (each with one share) are:—J. T. Peddie, 15, Victoria Street, E.C., director; B. J. Gripper, Hartham House, Hartford, gentlemen; A. W. Hill, Burnaby Gardens, Chiswick, engineer; E. J. Smyth, 94, Queen's Road, S.W., clerk; A. W. Read, 11, Ironmonger Lane, E.C., solicitor; H. M. Cordrey, 11, Ironmonger Lane, E.E., clerk; and R. B. Cannings, 11, Ironmonger Lane, E.C., clerk. Minimum cash subscription 10 per cent. of the shares offered to the public. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first. Qualification of any director not being a director of the Peddie Small Arms Corporation, Ltd., 250 shares; remuneration, £75 each per annum.

Electro-Chemical Industries, Ltd.—The memorandum of association only of this company was registered in Guernsey on April 29th, capital £300,000 in £1 shares, of which 199,993 are to be issued as fully paid, to acquire and develop inventions, patent rights, &c., relating to electricity and chemistry. The first subscribers (each with one share) are:—I. C. Ozanne, 5 and 6, Court Row, Guernsey, accountant; F. De P. Bienvenu, 1, Court Road, Guernsey, H.M.'s Deputy-Sergeant; T. B. Banks, High Street, Guernsey, merchant; F. I. Brownsey, 48, High Street, Guernsey, printer's manager; C. J. P. Ridgway, 4, Court Row, Guernsey, clerk; A. Martin, York House, Candie Road, Guernsey, merchant; and A. H. Singleton, High Street, Guernsey, hairdresser's assistant.

Auxiliary Electrical Co., Ltd. (84,453).—This company was registered on May 3rd, with a capital of £70,000 in £5 shares, to carry on the business of an electric light and power company in all its branches, to acquire or construct, maintain and control tramways and works for generating and supplying electrical energy for the purposes of light, heat, or power, and to carry on the business of mechanical engineers, engineers, manufacturers o

and dealers in electrical apparatus, &c. The first subscribers (each with one share) are:—H. Gordon, 12, Ovington Square, S.W., gentleman; H. W. Braine, 25, Hamfrith Road, Stratford, E., clerk; F. R. Reeves, Salisbury House, E.C., engineer; A. E. Mohring, 89, Gladstone Avenue, East Ham, engineer; S. R. Smith, 101, First Avenue, Little Ilford, clerk; T. W. Vickers, 65, Kensington Avenue, East Ham, clerk; and C. D. Braddon, 10, St. James' Road, Surbiton, engineer. No initial public issue. Registered without articles of association. Registered office: Salisbury House, London Wall, E.C.

CITY NOTES.

Western Telegraph Co.

The directors' report for the half-year ended December, 1904, says that the revenue amounted to £248,265, and the working expenses to £105,507. After providing £14,065 for debenture stock and debenture interest and sinking fund, and £4,821 for income-tax, there remains a balance of £123,831, to which is added the sum of £4,440 brought forward from June 30th last, making a total of £128,271. First and second interim dividends, amounting to £62,379, have been paid, and after transferring £60,000 to the general reserve fund, and £2,000 to the maintenance ships' reserve fund, there remains a balance of £3,892, which is carried forward. The revenue includes £11,808 6s. 6d. dividends upon investments in other telegraph companies, and £7,644 15s. 2d. interest on reserve fund investments.

Brush Electrical Engineering Co.

The annual meeting was held on Wednesday at Salisbury House, E.C., Lord Vaux of Harrowden presiding.

The Chairman, in proposing the adoption of the report (see Electrical Review, May 5th, p. 740) said that the feature of the reports in recent years had been the gradual, but substantial progress made by the company towards the attainment of a more healthy financial position, leading, they trusted, to one of sustained prosperity. This year they were again able to report a considerable increase in turnover—due not to any abnormal influences, but simply the result of unremitting care and hard work, rendered more efficient by continual efforts to perfect their methods of production and their business machinery generally. The real extent of the improvement that had taken place could not, however, be justly appreciated by a simple comparison of the accounts with those of the previous years. If the manufacturing industries were in a generally flourishing condition there might indeed be some ground for disappointment with the rate of their progress, but the published reports of leading electrical manufacturing companies rendered it scarcely necessary for him to tell them that in regard to the unremunerative character of the work undertaken, 1904 was even a worse period in their trade than the previous year had been, so that if they had merely held their own, as they had done, they would have given some indication of the strength of their re-organised system. That, however, hardly did full justice to the company's operations in the past year, for they had been actively engaged upon very necessary development work in various departments at Falcon Works, calculated to increase their profits in future years, but, for the time being, having just the opposite effect, inasmuch as the expense had been borne by the revenue of the year under review. Although the electrical industry was continually demanding new designs and new methods of manufacture, and the production of standard articles in quantities had to be interrupted occasionally for the sake of special lines, their organisation was now better able to deal with both classes of orders, and they were prepared with numerous designs, patterns, and working drawings which they anticipated would be very useful during the next few years, but the cost of which had been defrayed out of the revenue of 1904. The salient feature of the year's business had been the sustained activity of their rolling stock department, and the growing strength of their mechanical engineering and electrical business. They had executed large rolling stock orders for various municipal and other tramway undertakings, and they had now completed delivery to the Metropolitan District Railway of cars and trucks, which represented the highest class of electric railway vehicles yet constructed for service in this country. In view of the coming electrification of other railways, they had made careful preparations for handling large orders of that description. On the other side of their works, their business in electrical machinery and apparatus had been developing satisfactorily, and their expectations with regard to their new type of reciprocating engine had been fulfilled by the high efficiency attained by those which they had delivered to customers in different parts of the country. The net profit available was practically the same as in the previous year, and they recommended the payment of the full preference dividend, which would absorb £18,000; and the transfer of £7,000 to the general reserve fund, leaving £3,080 to be carried forward. The amount advanced by the British Electric Traction Co. now stood at £30,740, and the item of loans and overdrafts was reduced from £88,334 to £75,342, while of that a substantional proportion, £29,688, represented the amount drawn at the end of December upon a temporary advance for the purposes of their Bombay electric supply and tramways undertaking. That was a scheme of great promise from which they were justified in expecting profitable developments, and arrangements were already well advanced for the sale of the undertaking to a separate company on terms which would include the placing of large contracts with their company. They were already building motor-buses possessing features of special merit for practical purposes. As to the future, it was certainly more cheerful than when he last addressed the shareholders, and the prospects in the immediate future were such as not to give rise to the anxiety which the directors had experienced in the past.

Mr. W. L. Madgen seconded the motion.

Some discussion of an adverse character ensued, in which several shareholders complained of the large amount set against patents and goodwill, but eventually the resolution was carried.

Calcutta Electric Supply Corporation.

Col. A. J. Filgate, R.E., presided at the annual meeting held on May 5th, at Salisbury House, E.C. In moving the adoption of the report (see Electrical Review, April 28th, p. 699), he said that, considering the large additional capital expenditure incurred, the result of working during 1904 was satisfactory. The year's capital expenditure was £41,733, making a total of £424,503. During the year £3,995 was expended on land and buildings at Ultadanga, Alipore, and Emanbagh Lane; £15,996 on machinery and tools in connection with the plant for the two new stations; and £14,162 on mains. They had constructed 8 miles of overhead mains and 11 miles of underground mains. The total length of mains in operation at the end of the year was 53 miles of overhead and 74 miles of underground mains, or 127 miles in all. They had also constructed 3 miles of underground mains in substitution of overhead mains, which had not been changed over at the end of the year. The demand for new extensions showed no signs of diminution, and they must anticipate a large outlay under this head for some time to come. They had spent a further £6,615 on meters. To meet the capital outlay they issued 20,000 new shares at a premium of £1 per share, and they would probably have to consider the question of finding further capital at no distant date. The satisfactory increase in the business fully justified the outlay. The gross revenue from all sources had amounted to £60,243, compared with £47,139 in 1903, an increase of £13,104, or 27 per cent. The total expenditure was £30,744 against £25,591 in 1903. Omitting, however, the provision in the accounts for future renewals, the actual expenditure in 1904 had amounted to £24,207, against £19,625 in 1903, an increase of £4,582, or 23 per cent. The working expenses in 1904 consumed 40 per cent. of the gross earnings, while in 1903 the proportion was 41 per cent. The installations connected with the system increased from 1,387 at the end of 1903 to 1,814 at the end of 1904. At the end of 1903 the lamps and motors connected with the system amounted to the equivalent of 122,492, and at the end of 1904 to the equivalent of 163,853 8-c.p. lamps. The units sold to customers in 1903 amounted to 2,067,806, and in 1904 to 2,760,459. Under private lighting they had an increase of about £6,000, under power of about £5,500, under public lighting of about £400, while under rental of electric fans a small decrease was shown owing to some customers preferring to purchase fans instead of hiring them. In regard to expenses, coal had cost £790 more; salaries £610 more. Under repairs and maintenance the actual increase in outlay had been about £1,500, due to heavier repairs to machinery, and to two large machines having to be taken down and re-erected owing to the sinking of their foundations. In order to make a full provision for future renewals the total charge shown in the accounts under this head had been increased from £8,500 to £11,000, and a net sum of £6,537 had been credited to the renewal fund account, which now showed a credit balance of £21,815. There were further increases under management expenses and special charges which might be generally attributed to increased work. The net earnings for the year were £29,499 compared with £21,587 in 1903, an increase of 36 per cent. The directors recommended a final dividend for the half-year at the rate of 10 per cent. per annum, making, with the interim dividend, 8 per cent. for the year. Mr. Glass (a director) went to India last winter, and while there he looked into the company's affairs. He spoke very favourably of their prospects, and had given them a report containing many valuable suggestions which they were investigating, and which seemed likely to improve the company's position. The lamps and motors connected with the system had increased from the equivalent of 163,853 8-c.p. lamps on December 31st to the equivalent of 178,605 8-c.p. lamps on April 7th. On the strong representations of their managing agents, they had reduced the scale of charges to the consumers of current for lighting purposes from January 1st last on the condition that accounts were promptly paid. The site for the Howrah generating station had at last been secured, and the work of building the station was now in full swing. A considerable portion of the plant for this station was now in India. There had also been delay in starting the Ultadanga station owing to an exchange of lands in order to make a better site for the station and to settling the design for the station. It was believed that all questions had now been decided, and that this work would also be pushed on rapidly. Everything pointed to the continued prosperity of the undertaking and an increasing business for a considerable time to come. When the company was formed they were granted a licence for the supply of electricity under the Act of the Government of Bengal then in force, and they had had three new licences granted to them for extensions of their area on the Calcutta side of the Hooghly. Since that time a new electricity Act had been passed by the Government of India. The Government officials suggested to this company's agents that it would be desirable to grant the company a consolidated licence under the new Act in supersession of their present licences. In reply, they asked to be supplied with a draft of the licence which the Government were prepared to give under these circumstances. This they had now received, and while

this licence did not in any way damage them, in one important particular it placed them in a better position. Under their present licences, Government or the Calcutta Municipality could purchase the undertaking after the lapse of 21 years or in 1918 on the terms of paying the then value of all lands, buildings, works, materials and plant of the undertakers, suitable to and used by them for the purposes of the undertaking within such area, or part thereof, such value being agreed or estimated by arbitration on the basis of the value of the undertaking as a going concern. If they did not exercise this right of purchase, the licences would be prolonged for a further 21 years, after which the same authorities could acquire the undertaking on payment of the value of all lands, buildings, works, materials and plant of the licensees, such value, in case of difference, to be determined by arbitration. The new licence provided for the right to acquire the company's property at the end of the first 21 years on the same terms as the present licences, and further provided the right to purchase on the same terms after the completion of each subsequent period of 10 years, so that the licence would be a continuing one, and these new conditions were decidedly more favourable to the company than those of the existing licences. The directors had no hesitation in recommending shareholders to accept the new licence as now drafted.

Mr. E. Boulnois, M.P., seconded the motion, and it was adopted unanimously.

The ordinary business having been transacted, the necessary resolution authorising the directors to act in regard to the new licence was approved.

Mr. Glass having briefly referred to his visit to India and the excellent future that lay before the company, a resolution thanking the board and staff terminated the proceedings.

Elmore's German and Austro-Hungarian Metal Co.

The directors' report for 1904 says that all charges, except those for law costs and interest, show a reduction. The dividend to be received from the Metall Co. (£5,366) is greater by £2,446; and a loss of £3,081 made in 1903 has been converted into a small profit.

The result cannot be regarded as wholly satisfactory, for it was hoped that the dividend from the Metall Co. would be greater. The directors are, however, glad the company is once more able to show a profit instead of a loss, and they are satisfied, from what they have personally seen at Schladern, and from the increased sales, that a greater improvement may reasonably be anticipated from the present year's working. The directors draw attention to the fact that the total sum paid by this company and the Metall Co. by way of interest and commission amounted to £9,345 4s. Depreciation and repairs and maintenance charges in the Metall Co.'s account represent the large sum of £4,084 9s. 2d. These two items give a total of £13,429 13s. 2d. The shareholders will therefore realise how large the earnings must be to bear this burden and show a profit.

The accounts of the Metall Co. show a distinct improvement, there being an increase in the gross profit of M. 76,656.05, and in the net profit of M. 45,679.27, compared with the year 1903. For a considerable period, owing to the erection of the new plant, which included a 35-ton fly-wheel, output was retarded and the total production was reduced considerably in consequence. There was also delay in starting the new plant owing to late delivery by contractors, a serious accident, and other causes, with the result that the new plant did not get into working order until late in the year. The directors are pleased to report that the machine is fulfilling their expectations, and they are satisfied the company will reap considerable benefit by its introduction, the cost of production being considerably lessened by its use. The tubes produced by the new process are giving excellent results as to quality. The directors are also pleased to report a continuance in the supply of orders, and had they the plant and working capital the sales could be largely increased. Notwithstanding the increased value of copper on December 31st, 1904, no appreciation was taken in the value of the copper stock. Had the stock been taken at the price ruling on that day the profit would have been greater by over £10,000. In order to regulate production in Germany a syndicate of copper tube makers has been formed, with a central office in Cologne. The Metall Co. being the second largest copper tube makers in Germany, have been allocated the second largest share of the total production of Germany. The syndicate was not formed for the purpose of increasing prices, but of organising distribution and reducing management expenses. The directors have decided to increase the capacity of the factory by adding two additional draw-benches, but if it is desired to take full advantage of the business which is within the company's reach, still further draw-bench power will have to be added.

Messrs. MacFarlan, Heal and Garnett have waived £275 of their fees for the past year.

West Coast of America Telegraph Co.

Sir J. Denison Pender presided at the meeting of this company held at Electra House on May 2nd, and in moving the adoption of the report, he said that the gross receipts amounted to £42,333, as against £35,707, an increase of £6,330. The expenses at stations had increased by £2,600 to £17,261, the chief reason being the introduction of the recorder instrument. The company up to this time had used the mirror, and he thought they were the last using such an instrument, which was now almost out of date. It had served their purpose very well, but they found at the present time that the difficulty of getting mirror clerks in this country was so great that they had decided to introduce the recorder instrument which was used on most other cable systems. This would not only increase the speed, but would in other ways facilitate the carrying of their traffic. This had cost them about £1,111, and they would very likely have to spend another £200 upon it. After referring briefly to other items which had shown an increase, he referred to the maintenance of cables and landlines. In 1903 this had cost £12,155, but in 1904 it had only cost £9,203, or £3,222 to the good. He had always warned them against considering any real benefit which any particular accounts might receive from that item as a permanent saving, because they could never tell when the cables might go. That or more might be absorbed this year. They had had a certain expenditure on the cable-ship, because she had always been very difficult to handle for repairs in rough weather on account of her rough rolling. They had put bilge keels on to her at a cost of £450, and she was now able to work a cable in weather in which she could not have touched it before. The cost of this had been wiped out by a small "charter" they got. The directors proposed to put £6,000 to the general reserve, making it £10,185, and to put £1,750 to the ships' reserve, which would make it £4,000, and carry forward £766. He was sorry they were unable to pay a dividend, but in the past they had gone through a very difficult period, and they had been unable to make up any reserves. The reserves were now getting up, though £14,000 was not very much when they considered the capital and debentures, and income bonds. If they had paid the money away in dividends, the company would have been left more or less in a hopeless position should any unforeseen circumstances arise.

Sir A. Leppoc Cappel seconded the motion, and it was adopted.

Great Northern Telegraph Co., Ltd. (of Copenhagen).

The general meeting of this company was held at Copenhagen on April 29th.

The chairman and managing director, Commodore E. Suenson, D.R.N., in rendering an account of the working during the year 1904, said that the general state of their cables had been satisfactory, although interruptions had been unusually frequent. On 10 of the cables in Europe there had been 24 interruptions, and in the Far East 14 interruptions on five cables, apart from the two cables between Russia and Japan (Vladivostok and Nagasaki), which were closed by the belligerents on February 9th, and had since been lying idle. Their cable steamer in Europe—for the first three months the *Pacific*, and subsequently the *H. C. Orsted*, on the completion of her overhauling—had been on active service on cable repairs for 112 days. In the Far East the cable steamers—the *Store Nordiske* during the whole of the year, and the *Pacific* from June 23rd, on which day she arrived at Shanghai—had been similarly occupied for 176 days, 74 of which were for the account of others. The stock of spare cable which the *Pacific* took out from London for their Woosung depôt arrived there in perfect condition. The closing of their cables between Vladivostok and Nagasaki naturally rendered the Vladivostok route useless for all traffic between Europe and the Far East transiting Russia. They had fortunately been able to substitute the alternative route *viâ* Peking-Kiachta-Irkutsk, which was opened on February 23rd, 1904, and had worked satisfactorily, notwithstanding frequent accumulation of traffic between Irkutsk and St. Petersburg, owing to the great number of Russian Government telegrams between the capital and the seat of war. The Russian Government had exercised no control whatever over the traffic transiting Russia, and would prevent accumulation of traffic in future by increasing the number of wires between St. Petersburg and Irkutsk. In order to accelerate the transmission over the company's lines in Europe, not only of the above-mentioned traffic, but also of the whole Russian terminal traffic, the company had, with the consent of the Imperial Government, established a service of their own at the central station at St. Petersburg, for direct working with Great Britain, Sweden and Denmark, which had also benefited the transmission of telegrams between Russia and France. This service was commenced on June 1st, and had proved very useful, but also somewhat expensive to the company, as it necessitated the maintenance at St. Petersburg of a staff numbering from 30 to 40 Danish employés. The war between Russia and Japan—the third and most terrible of the wars which had raged during the last 10 years in the countries of the Far East connected by their cables—broke out on February 9th. The injurious effects of this war on the general commerce, industry and shipping of the world are sufficiently well known, and a natural consequence had been a decrease of the commercial telegraph traffic in some places. On the other hand, the increase in the political and Press traffic had been enormous. However sad the causes which had created this enormous traffic on the company's own lines, and also on those of the other telegraph undertakings in which they were interested, financially the year had been unique in the annals of the company. They were prepared for a decrease of £120,000 as a result of the considerable tariff reductions introduced by the London Conference in 1903, and had the fortunes of war been different, the decrease would have been heavier still. Instead of this, however, their traffic receipts had increased by more than £100,000, and, adding to this the profit from investments, they had a total net revenue which exceeded that of the hitherto most successful year, 1900, by about £28,900, although the expenditure had considerably increased on account of their expensive establishment at St. Petersburg, the maintenance of the third cable steamer, and the extra expenses necessitated by the transmission of the heavy traffic. The directors were able, thanks to the unique results of the year, to propose the distribution of a dividend of 12½ per cent., together with a quite exceptional bonus of 11½ per cent., making in all 24 per cent., of which 5 per cent. had already been paid. To do this it had been necessary to place but a very moderate amount to the reserve and dividend equalisation funds. Shareholders would no doubt approve of the proposal for increasing by 50 per cent. the amount set aside for the pension fund of the staff, whose numbers had been increased in about the same proportion during the past five years. The company had been engaged in prolonged negotiations with the British and Danish Governments relating to the laying of the cable which was to connect the Faroe Islands and Iceland with the telegraph system of the world. This project had been held in abeyance on account of the too platonic interest bestowed upon it by the majority of the Governments which were approached with the view of obtaining their material support towards its realisation. This disappointment notwithstanding,

Denmark and Iceland had stood by their offer to grant an annual subsidy of about £5,000 for 20 years. In relation to the cost and risk connected with the undertaking this contribution might perhaps appear small, but the realisation of the project was of such great importance for the navigation of the Atlantic, for the agriculture of the countries bordering on the coasts thereof, for commerce in general and for the passenger and goods transport between the old and the new world, that the directors had undertaken to carry it out before October 1st, 1905, conditionally upon the prolongation of the Anglo-Danish concessions of the company until 1925.

Prospectuses.—*Bruce Peebles & Co., Ltd.*—This company is before the public (the list closes to-day) with an issue of the balance of 10,000 6 per cent. cumulative preference shares of £5 each, and 10,000 ordinary shares of £5 each, both at par. Our readers will have seen from the report of the company, also the statement made by the chairman at the annual meeting, which appeared in our columns a week or two ago, that the business has increased very rapidly, and this progress and expansion have rendered further working capital necessary. All of the proceeds of the present issue will be applied to that purpose.

Electricity Supply Corporation, Ltd.—This company has been before the public with an issue of a further 20,000 ordinary shares of £5 each at par. The list was to close on Wednesday. The company is already operating electricity works in a number of places in the provinces, and is now about to proceed with undertakings in Hendon, Hitchin, Falmouth, and Dumbarton. The present issue is to provide capital for these purposes.

Cape Electric Tramways, Ltd.—An extraordinary general meeting will be held at the offices, 1, London Wall Buildings, E.C., on Tuesday, May 23rd, for considering a resolution to the following effect:—(*a*) "That this meeting of shareholders of the Cape Electric Tramways, Ltd., hereby instructs the directors of the company not to purchase the tramways of the Cape Town Consolidated Tramways and Land Co., either under the option to purchase or otherwise, and not to renew the lease thereof."

Worcester Electric Traction Co.—The capital expenditure to the end of 1904 was £114,319, of which £38,329 was incurred during the year. The directors propose to issue a further £25,000 debenture stock and £35,000 in ordinary shares in order to provide moneys for the discharge of liabilities in connection with the construction and equipment of the lines. The year's revenue came to £15,611, of which £5,216 remains for division. Of this, £1,500 is to be placed to depreciation and reserve fund, the ordinary shareholders receive 5 per cent. for the year, and £1,716 is carried forward.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to:—

British Columbia Electric Railway Co., Ltd.—Further issue of £100,000 preferred ordinary stock and £90,000 deferred ordinary stock.

And to allow the following securities to be quoted in the Official List:—

British Columbia Electric Railway Co., Ltd.—£115,000 5 per cent. cumulative perpetual preference stock, in lieu partly of the 5 per cent. cumulative perpetual preference shares now quoted.

Montreal Light, Heat and Power Co.—170,000 shares of £100 each fully paid of the capital stock.

The Committee has ordered the undermentioned securities to be quoted in the Official List:—

Electric Lighting and Traction Co. of Australia, Ltd.—Further issue of £70,000 5 per cent. first debenture stock.

Primitiva Gas and Electric Lighting Co. of Buenos Ayres, Ltd.—Further issue of £55,000 4 per cent. first debentures of £10 each, Nos. 4,451 to 5,000.

West African Telegraph Co.—The board announces a final dividend of 5s. per share, making 4½ per cent. for the past year. For the previous 12 months the distribution was 4 per cent.

Submarine Cables Trust.—For the year ended April the revenue amounted to £24,288 and the expenses to £1,161, leaving a balance of £23,127. After meeting payment of the coupons, £3,976 has been transferred to the redemption fund, leaving £92 to be carried forward.

South Staffordshire Tramways Co.—The report for the half-year ended December last states that the total revenue for the half-year amounted to £1,257. After deducting all expenses chargeable to revenue, there remains a profit of £663, which, added to the amount of £7 brought forward from the last account, gives an available balance of £670. The directors recommend a dividend of 1s. 8d. per share on the preference shares for the half-year, leaving to be carried forward £37. Negotiations are still pending with the Corporation of Dudley regarding the purchase of the lines within their area.

Altrincham Electric Supply Co.—The annual meeting was held in London last week, Mr. Henry Wolfenden presiding. The report showed that the gross profit for the year amounted to £4,203, against £3,280 in the preceding year, and £1,575 in 1902. The company is now supplying current to 808 consumers with 47,676, equivalent 8-c.p. lamps, and has a large number of installations in progress. The report was adopted.

STOCKS AND SHARES.

Wednesday Evening.

Trouble, political and domestic, has played havoc with Stock Exchange prices this week. The very frank article in Monday's *Times* upon the relations between France and Japan formed one reason for a general fall, and another was a heavy failure in the Stock Exchange itself. But the latter event, having been expected, somewhat cleared the situation, and as foreign politics, at the time of writing, do not seem to be shaping towards any general conflagration in Europe, markets are recovering all round. Electrical sections escaped the full force of the decline; in fact, the falls are not only few, but they are offset by several movements in the opposite direction.

Naturally, Home Railway stocks are weak. Metropolitan Consolidated have slid down to 94, after being 93½, and there are reports in circulation as to some accident having occurred to the electrical plant. Districts eased off to 38, despite the additions to board of directors. Central London Deferred dropped 2 points to 81½, and the Ordinary 1 to 92, more in sympathy with the general dulness than for any other reason. But City and South London remained steady at its lowered level of 42½, hopes being entertained that the reduction in the fares may mean an increase in the receipts. Great Northern and City Preferred "A" are 5⅜, and Baker Street and Waterloo Debenture at 99 to 101 is four premium above the issue price. The stock is now fully paid.

In the traction market there has been a certain amount of realisation of shares in order to pay differences incurred in speculation elsewhere. Anglo-Argentine Tramway Ordinary lost ⅛ at 8½, but the Preference are firm at 6. Belgrano Ordinary are 3⅜ and Buenos Ayres Grand National "A" first Preference have come into request at about 5⅞. City of Buenos Ayres Trams are 5¾, Calcutta Trams 5⅜, and Capes 1⅜; the last-named have not appreciably benefited by the apparent harmony amongst the remaining directors. London United Preference fell to 10½, and the Debenture stock to 100½, while Metropolitan Electric Tramway shares are a trifle harder, and the new Ordinary can be sold at 3s. for special settlement. The company's new picture-book advertisement was being passed round the market the other day, perhaps in order to show the pleasant spots to which members might flee from the worries of a distressed Stock Exchange. British Electric Traction First Debenture has hardened a point, but Westinghouse Debenture shaded to 91, and the Preference shares are 3.

Other Miscellaneous descriptions which exhibit changes in their quotations are Babcock & Wilcox, with a drop to 5¼ (the Stock Exchange defaulter already mentioned had some of these in his account). British Aluminium Preference, with rises of 5s. and 10s. to the credit of the 7 per cent. and the 6 per cent. shares respectively, and a fall of ½, which left Electric Constructions at the round sovereign. Callender's Preference lost a similar fraction at 5½, and Telegraph Constructions, heavily-priced shares as they are, fell £1 to 36. Edison & Swan Second Debenture has again put on 1 per cent. at 89½, and the stock is scarce.

Electricity Supply issues are decidedly firm. City of London Preference mark a 5s. rise at 14; St. James's are 5s. better at 14½, and one or two Debentures have increased their values. The only shares to fall are Westminsters, which lost 10s. at 12½. The improvement in City Preference was rather vaguely linked with the introduction of the City of London Electric Lighting Co. (Extension of Powers) Bill, which came before the Select Committee of the House of Lords on Tuesday for the first time. Charing Cross and Strand have not moved from 8, Metropolitans retain their rise at 18, South Londons and South Metropolitans are also unchanged at 4 and 17s. 6d. Buying of Kalgoorlie Electric Power Preference put the price up to 16s. 3d.; we noticed last week in this column that next October's dividend would be paid. The company's arrangement with the Kalgoorlie Electric Tramways is certainly satisfactory. River Plate Electric Ordinary are 9s. 9d., and the Preference, now *ex* dividend, have firmed up to 19s. 6d.

That Anglo-American Telegraph stocks should not have sharply dropped with the slump in American Railroad prices appears to be paradoxical, inasmuch as the Yankee market usually governs the Anglo-American Telegraph group to a great extent. But the cable company is, of course, doing very well out of the animation in Americans, and as there is a little Bear account in Anglo "A" prices are well held up, the Ordinary being only one lower at 60 and the Deferred ¼ unchanged at 15½. Other alterations call for little notice. Cuba Telegraph Preference at 15½ have lost the fraction, and West India and Panama eased off slightly. Reuter's yielded ¼ to 8 after their recent recovery, but Globe Preference show a ⅛ rise at 14⅞.

The only moves in the telephone section are a drop of 10s. in National Preferred to 108½ and of 1/16 in Oriental Preference.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1903.	1903.	1904	Closing Quotations May 3rd.	Closing Quotations May 10th.	Business done week ended May 10th, 1905. Highest	Lowest
34,800	African Direct Telegraph, 4 % Debs.	100	4 %	4 %	4 %	99 —102	99 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	2⅛— 2⅜	2⅛— 2⅜	..	..
119,700‡	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	74 — 77	72 — 77	..	..
763,590	Anglo-American Telegraph	Stock	60/6	61s.	2⅜%	£0 — 64	59 — 61	..	..
8,118,210	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5¼%	104 —107	106 —107	106⅝	105½
8,118,210	Do. do. do. Deferred	Stock	1/-	2s.	Nil	15⅝— 15⅝	15⅝— 15⅝	15½	15⅛
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	..	6⅜— 6¼	6⅜— 6¼	..	..
15,000,000$	Commercial Cable	$100	8 %	8 %	8 %	230 —240	230 —240	..	..
1,932,856‡	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	4 %	4 %	4 %	97 — 99	97 — 99	98⅛	98½
16,000	Cuba Telegraph	10	6½%	5 %	5 %	8½— 8⅝ xd	8½— 8⅝xd	8⅝	8⅝
6,000	Do. 10 % Pref.	10	10%	10%	10%	15½— 16½ xd	15 — 16 xd	..	..
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	3⅜— 3⅝	3⅜— 3⅝	..	..
6,000	Do. do. 10 % Cum. Pref.	5	10%	10%	10%	8½— 9	8½— 9	..	..
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	101 —103%	101 — 103	..	..
60,710‡	Direct United States Cable	20	8½%	8 %	..	11½— 11¾	11½— 11¾	11⅝	11½
78,500	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,900, Red.	100	4½%	4½%	4½%	100 —102	100 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	139 —142	139 —142	141½	139½
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	..	91 — 93	91 — 93	9 ½	92
1,896,814	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	106 —108 xd	107 —109 xd	..	..
400,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	14½— 14¾	14¾— 14¾	14⅝	14⅝
602,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	105 —107	105 —107	..	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	4 %	4 %	4 %	100 —102	100 —102	..	..
200,000‡	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	99 —101 xd	99 —101 xd	..	..
180,887	Globe Telegraph and Trust	10	£3 16 7*	5½%	5⅜%	10½— 10⅝	10½— 10⅝	10⅛	10⅛
180,687	Do. do. 6 % Pref.	10	6 %	6 %	6 %	14⅜— 14⅝	14⅜— 15	14⅛	14⅛
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	15 %	24 %	35 — 37	35 — 37	..	..
50,600	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,900, Red.	100	4½%	4½%	4½%	100 —102	100 —102	..	..
17,000	Indo-European Telegraph	25	10%	10 %	13 %	50 — 52	50 — 52	..	..
72,580	Monte Video Telephone Co., Ltd., Ord.	1	3 %	3 %	..	⅜— ⅞	⅜— ⅞	..	..
1,968,388	National Telephone, Pref. Stock	100	6 %	6 %	6 %	108⅔—109⅔	108 —109	109½	108½
1,906,607	Do. do. Def. Stock	100	4½%	5 %	5 %	101 —103	101 —103	102⅛	101½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12½— 13⅛	12½— 13⅛	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11⅝— 12⅛	11⅝— 12⅛	11⅛	11⅛
250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	5 17/32	..
9,000,000	Do. do. 3¾ % Deb. Stock Red.	Stock	3¾%	3¾%	3¾%	100 —102	100 —102	100⅜	..
1,988,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103¼—105½	103¼—105½	104½	104
179,318	Oriental Telephone and Elec. Nos. 1 to 171,594, fully paid	1	6 %	6¾%	6¾%	1½— 1⅝	1½— 1⅝	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	1 5/16— 1 7/16	1⅜— 1½	..	..
100,000	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	99 —102	99 —102	..	..
11,889‡	Reuter's	8	5 %	5 %	..	8 — 8½	7⅞— 8⅛	..	..
8,227	Submarine Cables Trust	Cert.	6 %	6 %	6 %	122 —125	122 —125	..	..
56,000	United River Plate Telephone	5	7 %	8 %	..	7 — 7½	7 — 7½	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	..	5 — 5⅛	5 — 5⅛	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	107 —109	107 —109	..	..
15,609‡	West African Telegraph, Shares	10	2 %	4 %	4½%	8 — 8½	8 — 8½	..	..
30,008	West Coast of America, 1 to 30,000 and 58,001 to 58,009	2½	Nil	Nil	Nil	⅜— ½	⅜— ½	..	..
150,000	West Coast of America, 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4 %	4 %	4 %	100 —102	100 —102	..	..
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	13½— 14	13¼— 14	13⅞	13½
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	101 —103	101 —103	..	..
563,380	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103 —105	103 —105	..	..
68,231	West India and Panama Telegraph	10	Nil	Nil	..	1 1/16— 1⅛	⅞— 1	..	..
84,563	Do. do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	..	8¼— 8⅜	8⅛— 8⅜	8⅜	8⅜
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	..	8 — 8½	7¾— 8¼	..	..
89,000‡	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	104 —106	104 —106	105	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

43,000	British Aluminium 7 % Cum. Pref.	5	Nil	Nil	Nil	4⅝— 5⅛ xd	5 — 5⅛xd	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	Nil	4⅜— 4⅝	4⅜— 5⅛	..	..
20,000	Do. do. 4% Funding Certs.	5	...	...	...	3⅛— 3⅜	.. — ..	2 15/16	..
900,000‡	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	98 —102 xd	98 —102 xd	103½	100
183,301	British Electric Traction	10	8 %	6 %	..	9⅛— 9⅜	9⅛— 9⅜	9⅜	9 5/16
156,437	Do. do 6 % Cum. Pref.	10	6 %	6 %	..	10⅜— 11⅛	10⅜— 11⅛	11⅛	11
1,000,000‡	Do. do. 5 % Perpetual Debenture Stock	Stock	5 %	5 %	5 %	120 —122	121 —123	121⅛	120⅜
250,000	Do. do. 4½% 2nd Deb. Stock Red.	100	..	..	4½%	96 — 98 xd	96 — 98 xd	97⅛	97⅜
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	5¾— 6	5¾— 6	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	5⅝— 6	5⅝— 6	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	104 —105	104 —105	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	⅞— ⅞	⅞— ⅞	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..
105,781	Brush Electrical Engineering, Ord., 1 to 105,781	2	Nil	Nil	Nil	⅜— ⅝	⅜— ⅝	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	1½— 2	1½— 2	..	..
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	92 — 95	92 — 95	..	..
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	79 — 82	79 — 82	..	..
85,000	Callender's Cable Construction shares	5	15 %	12½%	..	10⅛— 11⅛	10⅛— 11⅛	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	5 %	5 %	..	5⅛— 5⅜	5⅛— 5⅜	5 11/32	5⅛
800,000	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	107 —109	107 —109	109	..
1,963,208	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	92 — 94	91 — 93	92⅜	91
523,396	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	101 —103	101 —103	102½	..
523,396	Do. do. Def. do.	Stock	4 %	4 %	4 %	82 — 85	80 — 83	81⅛	..
1,380,000	City and South London Railway	Stock	3½%	2¾%	2½%	42 — 43	40 — 43	41½	..
85,000	Crompton & Co., Nos. 1 to 85,000	3	5 %	2½%	..	2 — 2½	2 — 2½	2	..
100,000‡	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	5 %	5 %	5 %	95 —100	95 —100	..	..
99,961	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,961	5	Nil	Nil	..	1 — 1½	1 — 1½	..	..
17,189	Do. do. "A" shares, 01—017,189	5	Nil	Nil	..	1⅞— 2⅛	1⅞— 2⅛	..	..
844,093‡	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	82 — 87	82 — 87	..	..
100,000‡	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	86 — 89	87 — 92	89	..
112,100	Electric Construction 1 to 112,100	2	8 %	4 %	..	1 — 1⅛	⅞— 1⅛	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	..	2¼— 2⅜	2¼— 2⅜	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	4 %	4 %	4 %	96 — 99	96 — 99	97½	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9½— 10	9½— 10	9½	9⅜
800,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	97 — 101	97 —101	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	15 %	15 %	11 — 12	11 — 12	11⅝	11⅝
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	5⅛— 5⅜	5⅛— 5⅜	5 5/16	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	109 —111	109 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10%	..	16 — 17	16 — 17	16 1/16	16
800,000‡	Do. do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	100 —103	100 —103	..	..
87,500	†Liverpool Overhead Railway, Ord.	10	1½%	1⅜%	1½%	3 1/16— 3 3/16	3⅛— 3⅛	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	9½— 9⅝	9½— 9⅝	..	..
87,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	86 — 88	86 — 87	85½	..
150,000‡	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	103 —105	103 — 05	104	..
540,000‡	Waterloo & City Railway, Ord. Stock	100	3⅛%	3⅛%	3⅛%	91 — 93	91 — 93	91½	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List

Bank rate of discount 2½ per cent. (March 9th, 1905).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).— ELECTRICITY SUPPLY COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years 1903.	1903	1904.	Closing Quotations May 3rd.	Closing Quotations May 10th.	Business done week ended May 10th, 1905. Highest.	Lowest
£		‡							
£9,377	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	£	8 %	10 %	10 %	9½— 10½	9½— 10½	10	9⅞
10,623	Do. do. 7 % Cum. Pref. ..	£	7 %	7 %	7 %	9½— 10½	9½— 10½	..	..
288,782	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	105 —108	106 —108	..	..
80,000	Charing Cross and Strand Electricity Supply	£	10 %	8 %	8 %	7⅞— 8⅛	7⅞— 8⅛	7⅞	..
80,000	Do. do. do. 4½% Cum. Pref. ..	£	4½%	4½%	4½%	5⅝— 5⅞	5⅝— 5⅞	5⅝	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	£	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛	5 1/16	..
40,000	Do. do. 1903	£	..	4½%	4½%	5 — 5⅛	5 — 5⅛	..	..
370,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	105 —107	105 —107	..	..
44,486	*Chelsea Electricity Supply, Ord.	£	4½%	5⅛%	6 %	6½— 7	6½— 7	6 3/16	..
150,000‡	Do. do. % Deb. Stock Red.	Stock	4½%	4½%	4½%	109 —111	109 —111	110⅝	110⅜
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	£	5 %	5 %	6 %	11 — 12	11 — 12	11 1/16	11⅛
40,000	Do. 6 % Cum. Pref., 1 to 40,000	£	6 %	6 %	6 %	13½— 14	13½— 14½	14⅛	13 13/16
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	5 %	5 %	5 %	123 —127	123 —127	1 23/32	..
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	4½%	4½%	4½%	103 —105	103 —105	104½	..
40,000	County of London Electric Lighting, Ord. 1—40,000	£	4 %	4 %	4½%	8½— 9½	8½— 9½	..	..
80,000	Do. do. do. 6 % Pref., 40,001—60 ..	£	6 %	6 %	6 %	12 — 12½	12 — 13⅛	..	..
400,000‡	Do. do. 4½% Deb. Stock	..	4½%	4½%	4½%	111 —114	111 —114	113	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	4½%	4½%	4½%	102 —104 xd	102 —104 xd	103½	103½
70,000	Edmundson's Electric Corporation, Ord. Shares	£	7 %	7 %	..	5⅞— 6¼	5⅞— 6¼	5 15/16	5¾
83,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	..	6⅜— 6⅝xd	6⅜— 6⅝ xd	6 1/16	6⅜
800,000‡	Do. do. 4½% 1st Mort. Deb. Stock ..	100	4½%	4½%	4½%	106 —108	107 —109	..	..
21,000	Kensington and Knightsbridge Electric Ord.	£	10 %	12½ %	12 %	12 — 13	12 — 13	..	..
136,000	Do. do. do. 4 % Debenture Stock ..	Stock	4 %	4 %	4 %	101 —103	101 —103	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	£	Nil	Nil	3 %	2½— 2⅝	2½— 3⅛	..	..
60,000	Do. do. do. 6 % Pref.	£	6 %	6 %	6 %	5½— 5⅝	5½— 5⅝	..	..
371,895	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	4 %	4 %	4 %	99 —101	99 —101	100⅛	..
100,000	Metropolitan Electric Supply, 1 to 100,000	£	7½ %	8⅝ %	10 %	18 — 19	18 — 19	18⅝	18⅛
76,121	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	£	4½%	4½%	4½%	5⅛— 5⅜	5⅛— 5⅜	..	..
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	4½%	4½%	4½%	109 —114	109 —114	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	3½%	3½%	3½%	97 — 99	97 — 99	99⅜	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	99 —101	99 —101	..	..
10,852	Notting Hill Electric Lighting	£	6 %	6 %	7 %	14½— 15½	14½— 15½	..	..
59,000	Do. do. 4% 1st Mort. Deb.	100	4 %	4 %	4 %	100 —102	100 —102	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£	14⅜%	14⅜%	14⅜%	13⅞— 14½	14 — 15	14⅝	14 1/16
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	£	7 %	7%	7 %	8½— 8⅝	8½— 8⅝	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	3½%	3½%	3½%	98 —100	98 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£	2½ %	4 %	4 %	2⅝— 3½	2⅝— 3½	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	79 — 83	79 — 83	..	..
65,000	South London Electricity Supply, Ord.	£	1½ %	3 %	4 %	3½— 4½	3½— 4½	..	..
100,000	South Metropolitan Electric Light and Power (*Late Blackheath and Greenwich Dist. E.L.Co.*) Ord.	£	Nil	Nil	Nil	1⅜— 1⅝	1⅜— 1⅝	..	..
50,000	7 % Pref.	£	Nil	7 %	7 %	13½— 13⅝	13½— 14⅛	1⅜	..
100,000	4½% 1st Deb. Stock	100	4½%	4½%	4½%	105 —108	105 —108	..	..
80,000	Urban Electric Supply, Ord.	£	5 %	5 %	5 %	4⅛— 5⅛	4⅞— 5⅛	4 15/16	..
80,000	Do. do. 5 % Cum. Pref.	£	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	5⅛	5 1/16
200,000	Do. do. 4½% 1st Mort. Deb. Stock Red	100	..	..	4½%	104 —106	104 —106	..	..
110,000	Westminster Electric Supply, Ord.	£	12 %	13½%	14%	12⅛— 13⅛	12 — 13	12 13/16	12 1/16
28,151	Do. do. 5 % Cum. Pref.	£	5 %	5 %	5 %	6 — 6½	6 — 6½	6⅛	..

Shares not officially quoted :—Mackay Companies, ord., 40⅜—41⅛. Pref. 73½—74½.

*Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	£*	No. of wks.	Total to date. £	£*	Miles open.	*
Aberdeen	May 6	2,486	+ 78	49	64,361	+ 5,438	..	..
Ayr	Apr. 29	622	+ 124	50	14,253	+ 760	8	..
Bath	May 3	1,495	+ 26	18	10,331	+ 588	12½	..
Birkenhead	„ 7	2,090	+ 101	5	5,382	— 9	13·5	..
Blackburn	..	..	..	..	..	..	13½	..
Blackpool	„ 4	2,490	+1,431	5	3,786	+ 251	8½	..
„ —Fleetw'd	„ 6	1,126	+ 485	18	4,673	+ 48	..	..
„ —Lytham	Apr. 27	952	+ 407	26	4,272	..	7½	..
Bolton	May 7	3,757	+ 272	6	10,463	+ 387	25	..
Bournemouth ..	„ 3	2,753	+ 752	5	5,419	..	10·15	..
†Bradford	Apr. 29	5,530	+1,530	3	18,305	+ 1,029	54	..
Brighton	May 7	2,036	+ 436	6	4,986	..	9½	..
Bristol	„ 5	10,389	+ 651	..	..	..	..	..
Brit. Elec. Trac. Co.								
Airdrie	Apr. 28	405	+ 12	17	3,294	+ 15	..	..
Barnsley	„ 28	983	+ 51	„	2,664	+ 36	..	..
Barrow	„ 28	567	+ 263	„	3,397	+ 740	..	..
Birmingham (City)	„ 28	‡12,200	+ 2 521	„	‡93,057	+ 5,904	..	..
Birmingham (Mid.)	„ 28	‡4,056	+ 969	„	‡29,478	+ 4,268	..	..
Devonport ..	„ 28	1,005	+ 10	„	7,484	— 338	..	..
Dudley—Sto'rb'ge	„ 28	2,110	+ 486	„	13,455	+ 608	..	..
Gateshead	„ 28	1,958	+ 240	„	14,883	+ 493	..	..
Gravesend, N'fleet	„ 28	521	+ 42	„	3,364	— 358	..	..
Gr'n'k, Pt. Glsgw	„ 28	1,288	+ 216	„	9,323	+ 1,3·6	..	..
Hartlepool ..	„ 28	564	+ 40	„	4,146	— 44	..	..
Kidderminster ..	„ 28	262	+ 38	„	1,632	— 69	..	..
Merthyr	„ 28	493	+ 1 3	„	3,147	— 119	..	..
Metropolitan ..	„ 28	‡5,158	+2,506	„	‡31,326	+14,8 5	..	..
Middleton	„ 28	836	+ 203	„	4,848	+ 436	..	..
Oldham — Ashton	„ 28	1,315	+ 207	„	8,162	+ 184	..	..
Peterborough ..	„ 28	344	+ 63	„	1,902	— 108	..	..
Poole	„ 28	710	+ 99	„	4,079	— 175	..	..
Potteries	„ 28	3,573	+ 50	„	27,948	+ 469	..	..
Rothesay	„ 28	357	+ 157	„	1,079	+ 61	..	..
Sheerness	„ 26	152	+ 51	„	981	+ 194	..	..
Southport	„ 28	722	+ 1 8	„	4,209	— 139	..	..
South Staffs. ..	„ 28	1,634	+ 178	„	11,345	— 550	..	..
Swansea	„ 28	1,461	+ 473	„	8,385	+ 504	..	..
Taunton	„ 28	108	+ 10	„	730	— 88	..	..
Tynemouth	„ 28	519	+ 27	„	3 106	— 548	..	..
Weston-s-Mare ..	„ 26	222	+ 78	„	690	+ 74	..	..
Wolverhampton D.	„ 28	894	+ 168	„	6,016	+ 218	..	..
Worcester	„ 28	669	+ 137	„	4,513	+ 897	..	..
Wrexham	„ 28	248	+ 9	„	1,667	— 106	..	..
Yorks. Wool. Dist.	„ 28	1,521	+ 268	„	9,952	+ 949	..	..
Burnley	May 6	2,080	+ 99	..	..	..	..	..
Burton-on-Trent ..	„ 7	661	+ 41	5	1,688	..	8½	..
Bury	Apr. 23	1,834	..	3	2,120	..	..	..
Cardiff	Apr. 29	4,244	+ 419	4	8,587	+ 38	..	..
Carlisle	May 6	439	+ 72	18	2,852	— 316	..	..
Chatham and Dist.	„ 4	1,425	+ 259	18	10,763	+ 1,243	9·8	+ ·8
Colchester	„ 3	449	..	40	8,634	..	18 75	..
Cork	„ 4	971	+ 54	18	7,547	+ 283	9·9	..
†Darlington	„ 6	194	..	5	985	..	4·9	..
Darwen	„ 5	501	+ 45	5	1,227	+ 34	4·36	..
Dover	Apr. 15	364	— 83	15	2,529	— 171	3	..
Dublin	May 5	10,469	+ 277	..	81,144	+ 900	48½	+ 1½
Dundee	„ 3	1,670	+ 14	..	..	..	..	..
East Ham	„ 6	1,697	+ 230	5	4,050	+ 19	..	..
Glasgow	„ 6	30,957	+2,798	4 1/7	701,520	+37,733	73½	+ 3
Gloucester	„ 3	668	+ 108	5	1,304	..	15	..
Halifax	„ 3	3,392	+ 643	5	7,183	+ 209	35½	+ 2½
Huddersfield	„ 6	2,205	+ 514	5	5,157	+ 325	..	..
Hull	„ 6	4,303	+ 232	5	11,146	+ 44	13	..
†Ilford	Apr. 29	546	+ 100	4	1,902	— 170	..	..
Ilkeston	May 3	259	— 21	5	593	— 144	3·5	..
Ipswich	„ 6	885	+ 55	5	2,102	— 159	10½	..
Isle of Thanet ..	„ 6	1,134	+ 302	18	5,540	+ 116	..	..
Kirkcaldy	„ 3	485	+ 73	..	..	..	5½	..
Lan'kshire Trm. Co.	„ 4	1,492	+ 239	18	11,570	+ 557	8·66	..
Leeds	Apr. 29	12,378	+1,455	5	28,767	+ 1,365	89½	+ 8½
Leicester	May 6	4,356	..	18	33,737	..	..	..
Liverpool	Apr. 29	21,108	+ 845	17	171,015	+ 7,098	108	..
L.C.C.	„ 22	26,469	+5,082	3	44,412	+ 7,405	47½	+ 7½
Lowestoft	May 6	308	+ 27	..	..	..	..	..
Manchester	„ 6	24,880	+1,360	5	61,648	+ 2,934	..	..
Newcastle	„ 6	7,493	+ 52	..	..	..	..	..
†Newport	„ 6	553	+ 81	5	2,893	+ 499	14½	+ 1½
Oldham	„ 7	3,274	+1,055	5	9,991	+ 2,567	23	+ 5½
Plymouth	..	..	..	..	..	..	..	..
Pontypridd	„ 6	414	..	5	951	..	3·33	..
Portsmouth	„ 6	4,125	+ 766	5	9,473	— 1,081	14½	..
†Reading	Apr. 27	705	+ 117	4	2,393	..	18·12	..
†Rochdale	„ 29	582	+ 462	4	2,864	+ 1,811	15·46	10·79
†Salford	May 1	4,003	+ 36	5	18,582	+ 252	30	..
Scarborough	„ 6	219	..	18	1,334	..	3½	..
Sheffield	„ 7	9,780	+ 614	6	28,699	+ 300	84½	+ 1½
Southampton	„ 3	1,888	+ 67	4	8,590	— 245	16·6	..
Southend-on-Sea ..	„ 3	764	+ 227	5	1,486	+ 107	6½	..
Stockport	Apr. 28	1,826	+ 291	4	2 282	+ 91	11½	+ 1
†Sunderland	„ 30	1,368	+ 233	4	5,093	— 101	21	+ 1
Tyneside	May 3	1,051	+ 376	18	6,365	+ 1,046	..	..
Warrington	Apr. 27	685	+ 82	4	1,311	+ 68	7½	..
West Ham	May 4	3,285	+1,827	5	6,743	+ 3,082	10 95	+6·4
Wolverhampton ..	„ 3	1,662	+ 534	5	3,615	..	..	..
Cen. London Rly.	May 6	13,570	— 230	18	126,912	+ 1,773	6	..
City & S. Lon. Rly.	„ 7	5,562	+ 35	19	55,248	— 2,699	6½	..
Dublin-Lucan Rly.	„ 5	260	+ 46	18	1,·35	+ 47	7	..
G. N. and City Rly.	„ 6	3,144	+1,304	18	28,643	..	3½	..
L'pool Overh'd Rly.	„ 7	3,259	+ 112	18	26,776	— 1,187	6·57	..
Mersey Railway ..	„ 6	3,423	+ 183	18	28,871	+ 1,652	4½	..

* Compared with the corresponding period of 1904. † One week only. ‡ Includes horse and other receipts.

INSTITUTION OF ELECTRICAL ENGINEERS.

THE ALTERNATING CURRENT SERIES MOTOR.

On 20th ult. Mr. F. Creedy read a paper on the theory of the series A.C. motor, with its experimental verification, and gave an account of some experiments on the commutation of these machines. The author adopted the circle-diagram as the best means of dealing with the theory, following generally upon the lines of the theory of the repulsion motor which he contributed to our columns a year ago. An abstract of a paper of this description would be useless to our readers, whom we must refer to the *Journal* of the Institution. The experimental results obtained by the author show a remarkably close agreement with the theory, and clearly illustrate the effect of varying the field and armature windings and the frequency upon the power factor, efficiency, &c.

The commutation experiments were carried out with the aid of a Duddell oscillograph; the results were materially affected by peculiarities inherent to the motor experimented on, and do not appear to afford any clue to the secret of sparkless commutation.

In an appendix, the author further discusses the theory of the series motor, symbolically treated, after Mr. Steinmetz's methods. A second appendix relates to the construction and the efficiency of the series motor, and a third deals with some additional experiments on the motor, after modifications in its design had been effected. All the work was carried out at the Central Technical College.

Discussion.

The discussion on this paper took place on April 27th, and was opened by Mr. Shoepf, who, while criticising the possibilities of Mr. Creedy's methods, offered some comments on the essential points of the design of single-phase railway motors, which was largely dependent on the space available. He was of the opinion that the highest frequency of motors of large capacity for railway work should be 25 cycles, but higher frequencies could be used for smaller work. He illustrated some interesting results obtained from tests of a locomotive equipped with two 150-H.P. S.P. railway motors. In the trial a mile was covered in 140 seconds, the acceleration being at the rate of ·96 mile per hour per second, and the train weighing 48,000 lb. The power factor of the motor rose to 96 per cent.

Mr. Alex. Russell, commenting on Mr. Creedy's circle diagram, in which the angle θ was stated to be constant, remarked that he considered that it would vary through a certain range. He further objected to the introduction of iron, as this introduced difference of wave shape, and it would therefore be better to consider the permeability of iron as constant. The paper showed clearly that the alternating-current series motor was not nearly so efficient as the direct-current series motor.

Mr. Calisch described the advantages of the system of series alternating motors adopted on the Baltimore and Schenectady Railway, where both D.C. and A.C. were employed in operating the trains. The efficiency of the motors was 70 to 79 per cent. in alternating working, and 75 to 85 per cent. in D.C. working. Commenting on the design of such motors, he thought that salient pole-pieces were preferable to distributed windings in case of burn-outs, being more accessible.

Prof. Carus-Wilson asked what air-gap was used in the A.C. motors referred to by the previous speaker. The designer was limited by questions of rating, and Mr. Creedy's experiments did not take that into account. The tendency of the designer to reduce armature-turns was similar in both A.C. and D.C. motors; he thought, however, that it was altogether impossible to draw anything like the starting torque from the alternating-current motor that was possible with the D.C. railway motor, and this would limit its use.

Prof. Ayrton defended Mr. Creedy's method of determining factors graphically (while admitting the possibility of error, due to the adoption of the sine curve), and then checking these results from practice. The results were instructive in many ways, and emphasised the necessity of diminishing the importance of the field, and increasing that of the armature.

Mr. Mordey, referring to President Arnold's address at St. Louis, said that the latter appeared to question whether electrical engineers were going to have it all their own way in regard to the electrification of railways. Personally, he did not think that we should see the end of the steam locomotive during our lives. There was nothing to choose between the A.C. and D.C. motor as regards sparking, and the former could do anything that the latter did, but with a loss in efficiency; this loss might be twice as much.

Mr. Creedy, in replying, pointed out that he had directed attention to the rating of motors, at the end of his paper, and that it was possible to get even greater momentary overloads with A.C. motors than with D.C. motors.

After a few words from the President directing attention to early experiments on series alternating-current motors, which were carried out at a time when only lighting was regarded as of importance, the meeting was adjourned.

FITTINGS.

In his paper on "Fittings; Evolution in Design, and Some Conditions Affecting Design," read before the Glasgow Local Section on April 11th, Mr. Harold Watson treated the subject from a standpoint far removed from that of the selling agent or the manufacturer. He approached it rather from that of the art critic, the connoisseur of *bric-à-brac*, without, however, neglecting the utilitarian aspect of the subject. The author referred to the evolution of the apparatus used for artificial lighting, from the primitive oil lamps of the ancient Greeks, to the elaborate and artistic gas fittings of the nineteenth century; the latter exercised considerable influence over the nascent electric light fitting, and to no small extent embarrassed and delayed the development of designs adapted to the flexible and unrestricted character of the electric glow lamp.

When designers became more familiar with the capabilities of the incandescent lamp, they broke through the trammels of tradition, and revelled in floral designs, sheet metal foliage, "twirly" wrought-iron scrolls, &c.; later, attention was turned to the modelling of the framework of the fittings, the improvement of the glass shades, and so on, until the present high standard of excellence was attained; but the author considers that we are still very far from having reached finality. His complimentary allusions to the admirable catalogues issued by manufacturers of electrical fittings are well deserved.

The influence of Schools of Art, which are now to be found in almost every city, is, in the author's opinion, of increasing importance in educating the public taste, and the demand for new and original designs of fittings for new buildings also has a marked effect upon industrial art. In the case of the latter, the author points out the difficulty in realising the relative proportions of fittings when drawn in flat elevation to a small scale, whence it often results that the fittings, when made and installed, are too large for their surroundings. To avoid this defect, it is advisable to fix up temporary models of the fittings in position, in order to judge of their fitness, before making the actual apparatus.

The design of fittings for old houses is also beset with difficulties, not least of which are the purchaser's idiosyncrasies. Even a dealer in fittings ought to be able to judge of the style or period of the existing decorations of the rooms, and to conform thereto in providing designs for electric fittings. In many cases a capable artist should be employed to prepare detail drawings in the style required for churches, halls, &c., before the work is put up for tender.

The author points out the enormous difference between gas lamps, which must be placed at a distance from the points to be illuminated, and the electric lamp, which can be placed in almost any position; the latter feature, moreover, renders it possible to conceal the source of illumination in recesses. Mr. Watson believes that the adoption of such lighting from hidden sources will receive more general attention in the future, and justly remarks that this may be considered as marking a higher state of civilisation.

Mr. Watson's paper was illustrated by a number of sketches and drawings, though he avoided the mistake of allowing these to gain the mastery over the literary treatment. His paper was interesting in itself, gracefully written, and of a nature calculated to raise the subject to a plane far above the sordid associations of the show room.

STAND-BY CHARGES: AND MOTOR LOAD DEVELOPMENT.

On Thursday last week Mr. A. M. Taylor's paper on the above-named subject was discussed at the Society of Arts. The author made the following introductory remarks:—The present paper starts with the assumption that existing prices for power from small stations are prohibitive, as far as the capturing of continuous loads is concerned; and that where they are not prohibitive they are unsound, except in a few favoured towns where the motor load does not clash with the lighting load.

Analysis is made of the charges to be levied per unit for two classes of motor, representing extremes in load factor, viz., Class I., having a 30 per cent. load factor, and Class II., a 7½ per cent. load factor.

The investigation is first made into charges for what are called "interest-paying" motors—*i.e.*, motors which are charged a sum to cover interest and sinking fund on new generating plant and mains, rendered necessary by the overlapping of the lighting and motor loads. The results are given in columns (2) and (4) of Table A.

A suggestion is then made to sell power at extremely low rates on the basis of the current being cut off during "peak" hours.

The generating plant having thus been protected, so far as the regular evening peak is concerned, the question arises as to how far a day fog may endanger the lighting supply from the station.

A case of quite phenomenal motor load development is worked out in detail, and the results show, the author thinks conclusively, that in any provincial town it would be perfectly safe to offer the suggested low rates without any danger of a day fog causing the lighting to be shut down; and even in London the system could be worked at the same rates if due precautions were taken to protect the lighting.

Means are also indicated in the paper for further extending the load which might be taken up, should the development be exceptionally rapid.

Stand-by charges are next considered, and possible improvement in the works cost, due to the elimination of these, is worked out. Results so obtained are then combined with the other reduced charges consequent on supplying the additional units on the "restricted-hour" system, and are tabulated in columns (3) and (5) of Table A.

The "restricted-hours" system has the advantage over a two-rate meter system, that a much lower price can be offered, because with the former no material expense whatever, either in plant or mains, has to be incurred; whereas with the latter it would seem that an

extra charge must be levied on all units, and not only those which are inside the limits of the peak; otherwise the charges on the latter would probably bring them above even lighting charges.

In Montreal, where consumers of Class I. are charged respectively 1·24d. and 1·60d. per H.P. per hour for "restricted hours" and "unlimited hours" supply,* some 30 per cent. of the H.P. connected is voluntarily taken up on the former basis out of a total of 21,000 H.P. connected to the mains.

If only half† this proportion were to hold for the 500,000 H.P. which, we are told, is going to the lowest bidder in London, there would be 75,000 H.P. in London which could be obtained on the "restricted hours" system at the present time without a penny being spent in generating plant. Taking account of the fact that they are essentially manufacturing towns, it is probably safe to say that in, let us say, Birmingham, there must be quite 15,000 H.P., and in Sheffield 12,000 H.P., similarly obtainable, and in other towns in proportion. Will anyone maintain that this load is so insignificant as to be not worth the catering for? And would it not bring in its train quite a large proportion of "interest-paying" motors?

A suggestion is made *for tiding over the peak load* by a special arrangement of accumulator cells on consumers' premises. The author has ascertained that responsible accumulator makers would be prepared to maintain cells, under the conditions stated, at not more than 10—15 per cent. of the capital cost per annum.

Table D. shows that on this basis a municipal electric lighting station could offer power at charges which would be of the order of only 50 per cent. ‡ of their present rates.

The author suggests that the "*restricted hours*" *system at ½d. to ¾d. per unit*, supplemented by the private battery systems at ½d. per unit additional, will be found to provide a means for obtaining a class of load hitherto out of reach. The system might also be used to "prospect" for battery sub-stations.

TABLE A.—Summary of Results.—Actual, and Possible, Selling Prices for a 5-H.P. Motor.

—	Electric lighting only. Average of several stations of 2,000 KW. and under. 15 % load factor.	Motors of Class I. Station LF = 30 % DF = 1 Maximum load = 2,000 KW. No night load assumed.	Motors of Class I. Ditto on "Restricted hours" system. Station LF = 46 % (37 % motor load 15 % lighting load) Small night load as per fig. 1.	Motors of Class II. Station LF = 11 % (7½ % × 1·5) DF = 1·5 Maximum load = 2,000 KW. No night load assumed.	Motors of Class II. Ditto on "Restricted hours" system. Station LF = 20½ % (13½ % motor load 15 % lighting load) Small night load as per fig. 1.	Motors of Class I. only. Station LF = 30% DF = 1 Maximum load = 10,000 KW. No night load assumed.
Works costs*...	1·20d.	·70d.	·45d.†	·95d.	·50d.‡	·40d.
Interest and sinking fund at 7 per cent. on productive capital only**	1·00d.	·45d.	Nil	1·21d.	Nil	·32d.
Maintenance, salaries, and office	·23d. (·115 + ·115)	·079d. (·022 + ·057)	·018d. (·022 × 39/37)	·242d. (·104 + ·138)	·090d. (·104 × 11/131)	·039d. (·022 + ·017)
Rates, taxes, &c.	·14d. (·12 + ·02)	·040d. (·030 + ·01)	·008d. (·01 × 39/37)	·073d. (·060 + ·013)	·011d. (·013 × 11/131)	·033d. (·025 + ·008)
Net profit	·37d.	·18d.	·06d.	·44d.	·165d. (·06 × 37/14)	·14d.
Selling price	2·94d.	1·45d.	·54d.	2·91d.	·77d.	·93d.§

* See Table B. (of paper). ** See fig. 9. † Reduced from ·70d. by subtracting "stand-by" losses. ‡ Reduced from ·95d. by subtracting "stand-by" losses. § Estimated results, selling on ordinary terms with a station of five times the size.

Explanation of Table A.

In the first column the author gives average results obtained with stations of about 2,000 KW. capacity, having no traction load. Interest charge on what the author calls "unproductive" capital is entirely omitted. This is the cause of the low selling price, viz., 2·94d. per unit, which, however, includes interest on £70 for every kilowatt of station output.

In the second and fourth columns are tabulated the results obtained for motors of Classes I. (full load continuously) and II., intermittently loaded; in the paper no other load on the station than the motors is considered, and night loads are not assumed.

In the third and fifth columns, a "day" load on the "restricted hours" principle is assumed to be taken up by an already existent 2,000-KW. lighting station in the manner indicated in fig. 1 of the paper (see Electrical Review, January 13th, 1905, p. 76). No additional generating plant has to be put down; hence those items of charge analysed under Class I. Motor are only in part debitable to the new load. For example, no material addition to the management and technical staff will be necessary, though it will be to the office staff, hence the former item is dropped (being already borne by the lighting) while the latter is retained.

Again, the assessment of the station will probably remain unaltered, so long as no additional capital is spent on the station. The first part of the "Rates, &c," item has therefore been dropped, and only the second inserted. For the same reason, and for the additional one that, if the offer meets with anything like the response which the station is capable of dealing with, the load factor of that part of the station load which belongs to the motors would be of the order of some 40 per cent., the item for "net profit" has been reduced to 0·06d. per unit. Even at this small figure, it would represent nearly £1,400 per annum on 5,500,000 units.

The item for "works cost" is reduced to 0·45*d.* from 0·70*d.*, eliminating all "stand-by" charges, which are supposed to be already borne by the charge made on account of lighting.

The discussion was opened by Mr. C. P. Sparks, who said that he disagreed with the author on one or two points. The competition of other motors with the electric motor was not of so severe a character as the author appeared to think; the electric motor was the motor of the future, and in many cases choice was restricted by circumstances to electricity. Referring to diversity factor, which was difficult to ascertain reliably, in lighting it was poor, but in a motor load it was certainly higher than the author imagined; capital charges were also less than in the paper. He further considered that the cost of generation was assumed at too high a figure, and that intermittent supply was in many cases impracticable.

Mr. W. C. P. Tapper disagreed entirely with the author as to the practicability of the restricted hour system, his experience with it at Stepney having quite convinced him of the difficulties attending its use. The author's assumptions in regard to diversity factor were also incorrect; in Stepney the diversity factor was 4·4, and it was rapidly increasing; while at Glasgow on the tramway load, it was 7·75.

Mr. J. S. Highfield commented on the despairing tone of the paper; in his opinion, the supply authorities could and were selling energy at rates which paid the user. In regard to the overlapping of the lighting and motor loads during a fog, which the author had estimated at 60 per cent., on the Metropolitan Co.'s system it amounted to 80 per cent., and this would increase capital charges. He pointed out the importance of calculating the load factor, weekly instead of yearly when considering costs, as, owing to the increasing connections during the year, the load factor was higher per week than per year, and the works costs were, therefore, not so bad as they appeared in the yearly calculation. Any system which necessitated the running of separate circuits for motors and lighting to a consumer's premises, would be awkward to work. He further remarked that in the case of combined plants, a fog would shut down the tramways at the same time that it increased the lighting load, so that no overlapping would occur.

Mr. Jeckell based his remarks on the author's comparative figures of cost of gas engine and motor driving; they were, in his opinion, not in accord with practice. In Coventry he received an average of 1½d. per unit for motors. The average horse-power of motors on circuit during the past year was 905, the average units per H.P. per annum was 944, the average cost per H.P. for a 2,500 working-hour year, amounted to £4 16s. 10d.. or ·46d. per H.P.-hour, as compared with the author's figure of 1·0d. per B.H.P.-hour. It would, in fact, have been impossible to supply energy in Coventry for motor purposes at the author's figure. The speaker adduced further evidence in regard to the figures for gas and electrical driving, mentioning a case of a firm who superseded a 36-H.P. gas engine by several electrical motors, and found that the difference in favour of electrical driving amounted to £11 per quarter, and this did not include the saving in water cost and floor space. As a matter of interest he had obtained from a firm the actual costs per B.H.P.-hour for a gas engine using gas at 2s. 1d. per 1,000 cb. ft., and these he contrasted with the author's figures (the latter in brackets). Gas consumed, ·47d. (·87d.); lubricant, ·01d. (·05d.); interest, ·048d. (·55d.); wages, ·088d. (·91d.); total, ·616d. (2·38d.). This, on the basis of 2,500 working hours per annum, meant a cost per B.H.P. per annum of £6 18s., as compared with the author's £25 approximate. Taking the column for electrical driving and comparing it in the same way, he found the author's figure amounted to over £14 per B.H.P. per annum, as against an ascertained figure of £6 approximate.

Mr. W. H. Patchell commented on the complexity of the author's diagram, fig. 7, which he thought could have been made clearer. In regard to diversity factor, the peak loads of the City and West End areas of the Charing Cross Co. coincided almost exactly. He expressed the opinion that motor loads were liable to be misleading, instancing the case of a certain theatre equipped with numerous motors, where a load of 150 KW. came on for 1½ minutes, twice a day. He thought that the author had under-

* The flat rates are £10 and £21 per H.P. per annum.

† With the greater reduction in price this should certainly be exceeded.

‡ Only 60 per cent., if maintenance costs were doubled.

estimated accumulator maintenance, for the small isolated plants proposed and mentioned that lighting and motors often went together, especially in basements which were largely utilised for motor-driven machinery.

Mr. VIGNOLES defended existing power tariffs; in his opinion 1d. per unit was a sufficiently low price. He compared the running costs of the gas engine and motor to the advantage of the latter, giving it as his opinion that a motor running nine hours per day, would almost certainly have a variable load, which would, of course, introduce the diversity factor. He considered that the author's suggested prices for restricted hours supply were all too low. In Grimsby they had both a sliding scale and a time-switch system, and a large proportion of their motors were obtained on the latter system. It was an excellent inducement to motor customers, who however, so soon as they recognised the advantages of electrical driving, generally found it paid to change over to the sliding scale. He, in common with other speakers, condemned small isolated accumulators, as it would be better to install battery sub-stations. He concluded by referring to the results obtained from tests of steam and coal consumption with various load factors and average loads at the Grimsby electricity station.

Mr. R. A. DAWBARN expressed the opinion that motors should take a due proportion of capital charges in proportion to the top load. He thought 1d. per unit was not low enough for many classes of restricted hour consumer. Some years ago the Huddersfield Electrical Department took on a consumer at §d. per unit, on the understanding that the supply should be cut off during the four heavy load hours of the day. The cost of power at a cotton mill using 1,300 H.P. came out at ·231d. per H.P. including capital charges, and this only amounted to about the cost of ordinary electrical distribution, leaving nothing for cost of energy. At Huddersfield, distribution costs were obviated, the consumer having to set up works next door to the electrical station. He considered that the cost of the author's accumulator arrangement would far outweigh extra feeder costs, owing to the small sizes proposed.

Mr. A. M. TAYLOR, in replying, remarked that he thought that, as regards the diversity factor, all at least would agree that, where they had a number of motors all fully loaded and continuously loaded, the diversity factor of such a system was unity. He had called the load factor of such motors, taken over a cycle of, say, one hour, a 100 per cent. load factor. Where the cyclic load factor, similarly understood, was 25 per cent., the diversity factor would, in the limit, be = 4. Similarly, if the load factor of the motor were only 10 per cent., the diversity factor would be 10 in the limit. In order words, for any cyclic load factor of motors the diversity factor of the station was the reciprocal of that load factor, assuming all the motors to be of the same class, and the cylic load factor of the station was equal to the motor load factor multiplied by the diversity factor. He was surprised at the poor results obtained at Stepney with the restricted hours system, and contrasted them with the phenomenal success of that system at Brighton. In reference to Mr. Jeckell's figures, he suggested that the B.H.P.-hours were probably over-estimated, which would, of course, account for his low cost figures. He considered that both lighting and motors could be treated on the same basis, with equivalent demands, and suggested that there were, all considered, many trades where the restricted hours system was practicable.

Mr. ARTHUR WRIGHT (communicated)—I think the clear way in which Mr. Taylor has shown in diagram 7 how to determine the stand-by losses, under any conditions of load, requires acknowledgement by all of us. In my opinion, the form of graphical analysis adopted for this purpose is entirely sound and extremely useful. I am of the opinion that it is sounder to aim, at the present time, at a fixed return on the capital involved, rather than a fixed percentage on the cost of producing each unit; the increase of business obtained by the addition of the motor load will probably take care of this second point. I am at issue with the author in his desire to chiefly obtain those motor loads which do not entail material capital expenditure. If a motor business produces a fair return on capital expenditure—say, 10 per cent.—it is certainly worth having, and the more capital we can get expended with this assurance, the better it must be for everybody concerned. The reason why, I think, the author is led to over-value this non-interest-paying motor business is, that he has quite under-estimated the enormous diversity factor existing in a large motor business. Instead of the diversity factor being as low as the author assumes—namely, 1½—which is much lower than the diversity factor of the large lighting system in Brighton, I believe that the diversity factor of 2,000 or 3,000 KW. of motors distributed in a manufacturing town will be nearer 6 than the author's limit of 4. As this important question of diversity factor of a motor business is the one which will have the greatest effect in lowering the cost of supplying electricity (on account of its reducing effect on the capital involved), I should like Mr. Taylor to re-consider his figure of 1·5, as on the true value of the diversity factor depends very much whether he is right in assuming that electricity for motive power, unaccompanied by restrictions, cannot pay in the majority of stations at 1d. For reasons already stated, I entirely disagree with the author's statement that "the station" load factor is obtained by multiplying the "motor" load factor by the "diversity factor." It seems obvious to me that the diversity factor of a large motor business is due to the non-simultaneous use of the motors during the two periods before and after lunch in the working day, and does not have any connection with the number of hours in the year the machinery is at work.

Mr. S. E. FEDDEN (communicated)—I do not consider it necessary to class the motors according to their load factors; they naturally level up all differences themselves. In 4,000 H.P. connected to my mains I have blowing motors running 100 hours per week; rolling-mill motors on and off every half minute; elevators, &c.; they all level up on the generating plant to about 30 per cent. of the connections, and give a steady load with practically no fluctuations. I do not believe in any complicated or "cut-off peak load" charge. Let your charges be simple and straightforward, so that everyone can understand them. I do not consider there is any chance of the lighting load and motor load swamping the power house, as with the present satisfactory state of generating plant I should feel quite justified in risking my spare plant being in a condition to run one or two hours per day for two or three months in the winter when the two loads overlap slightly. There is no fear from day fog in a provincial town, where there is a lot of private house lighting, as only a very small proportion of this will come on on the blackest day. In most circumstances I totally disapprove of batteries on consumers' premises or in sub-stations, as they bring in needless complications. Given a big load and a long load, a sound economical generating plant, reliable mains of big enough sectional area so as not to have too much drop, overground disconnecting boxes or pillars for quickly locating and clearing faults, a simple method of charging, the lowest possible rate per unit for lighting, power and heating, and the motor (or long) load will soon develop and the stand-by charges practically disappear.

We have received the following letter from Mr. Taylor:—

With your permission I should like to comment further on two points which were raised at the discussion of my paper on Thursday. The first point—a very pertinent one—was raised, I think, by Mr. Sparks, and I regret to have overlooked it in replying. Mr. Sparks asked why, in column 2 of Table A, I had taken works cost at 0·7d., whereas in column 3 I had reduced it to 0·45d. The reason is that with a motor load which clashes with the lighting load, we cannot get rid of "peak" conditions in the working of the plant, and my fig. 7 and the tables on pp. 26 and 27 show that under such conditions the boiler and other standby losses will never attain their minimum.

On the other hand, with the "restricted-hour" load superposed on the "interest-paying" motor and lighting loads, the "peak" is less prominent (in contrast to the valleys) on the daily load curve, and the generating charges are reduced *below* what they would be with the interest-paying lighting and motor load alone, and, of course, still further below those with the lighting load alone.

The "restricted-hours" system is, I understand, in use at St. Pancras, and also by the County of Durham Co. Perhaps Mr. Baynes or Mr. Esslemont, though unable to take part in the discussion, may be willing to give us, through your columns, some indication of its success in either place.

The other point on which I should like to make a few remarks is the question raised by Mr. Jeckell. The figures given us by Mr. Jeckell were most interesting, but, unfortunately for the electric motor, they prove my figure of one unit per B.H.P.-hour to be only too near the truth, where the motor is a small one and is working at one quarter of its rated load.

Your readers shall judge for themselves. The following figures were given us by Mr. Jeckell:—

Revenue derived from motors	£4,385
Units sold for motors	854,543
Hence—	
Average price per unit...	1·23d.
Total H.P. of motors	905
Units sold per H.P. installed per annum ...	944
Average cost per H.P. installed per annum ...	£4 16s. 10d.
Number working hours per annum	2,500

Hence—

$$\text{Cost per B.H.P. per hour} = \frac{£4{,}385 \times 240}{905 \text{ H.P.} \times 2{,}500 \text{ hours.}} = 0{\cdot}46\text{d.}$$

$$\text{Now—Energy per B.H.P. per hour} = \frac{\text{pence B.H.P hour}}{\text{pence per unit.}}$$

$$= \frac{0{\cdot}46}{1{\cdot}23} = 0{\cdot}38 \text{ unit per B.H.P.}$$

The above result looks very plausible, and none would welcome it more than the writer, but it goes against the principle of the conservation of energy. Where, then, is the "nigger"? Simply that, as pointed out in my reply, Mr. Jeckell multiplies the *rated* H.P. of his motors by the hours of running, and calls this the B.H.P.-hours.

To get the B.H.P.-hours *developed*, this figure should be multiplied by the ratio of the average H.P. developed to the rated H.P. of the motor.

For instance, at Coventry:—

Units sold per H.P. installed per quarter = 236, whereas, with my Class I. motor (see p. 3 of my paper):—

Units sold per H.P. installed, and developed, per quarter = 585.

$$\text{Hence, } 905 \text{ H.P.} \times 2{,}500 \text{ hours} \times \frac{236 \text{ units}}{585 \text{ units}} = 913{,}000 \text{ B.H.P.-hours,}$$

whereas Mr. Jeckell has taken 2,250,000 B.H.P.-hours.

$$\text{Hence, also, 0·38 unit per nominal H.P.-hour} \times \frac{585}{236} = 0{\cdot}94 \text{ unit}$$

per B.H.P.-hour, which is near enough to my figure to suit most people.

With reference to my Table C., it may be some consolation to Mr. Jeckell to be able to inform the gasman that the 1·37d. there given represents the cost of 4 hours' working, and not of 1 hour, because it refers to a motor working on the average at ¼ of its rated load (my Class II.).

Perhaps, Mr. Editor, you may be able to find room in your columns for my revised Table C, which is a copy of the lantern slide exhibited on Thursday last, and embraces a larger range than does the original table.—Yours faithfully, A. M. Taylor.

Two boiler rooms are erected, one opposite to each line of furnaces, with an engine room between containing two 100-H.P. coupled sets. After leaving the boilers the flue gases pass through two centrifugal dust catchers and thence to the chimney.

Table C.—Costs per B.H.P.-hour.

—	Class I.		Class II.*					
	5 H.P.		5 H.P.				35 H.P.	
	Electricity at ·55d. per unit.	Gas suction with anthracite at 24s.	Town gas at 2s. 1d.	Petroleum at 45s. per ton.	Electricity at ·77d. per unit.	Gas suction with anthracite at 24s.	Electricity at ·70d. per unit.	Gas suction with anthracite at 24s.
Gas, oil, current or anthracite consumed	·55d.	·20d.	1·00d. ($87 \times \frac{4\cdot2}{36}$)	·25d.	·77d.	·30d.	·70d.	·27d.
Lubricant, waste, &c.	·012d.	·05d.	·20d.	·20d.	·05d.	·20d.	·04d.	·20d.
Interest and maintenance charges (at 4 per cent. and 10 per cent.)	·09d.	·28d. ($1\cdot11 \times \frac{1}{4}$)	·55d.	1·61d. ($·92 \times 1\cdot75$)	·35d.	1·11d.	·23d.	·44d.
Wages { 5 H.P., 10s. and 5s. ... / 35 H.P., 20s. per week ...	Nil.	·46d. (10s. per w'k)	·91d.	·91d. (5s. per week)	Nil.	1·83d. (10s. per w'k)	Nil.	·53d. (20s. per w'k)
Totals	0·65d.	0·99d.	2·66d.	2·97d.	1·17d.	3·44d.	0·97d.	1·44d.

* The costs given under this heading are those for a period of four hours, working at a quarter of the full load.

THE NEW REFUSE DESTRUCTOR PLANT AT BRUSSELS.

We have received a translation of some notes by Mons. J. Leurs, Alderman of Public Works of the City of Brussels, descriptive of the new destructor plant. Besides the description proper, these notes contain considerable information with regard to the sanitary arrangements both in Brussels and other Continental and British towns.

It has been estimated that in Berlin the total amount of refuse, including sweepings, kitchen refuse, cinders and residues of coal fires amounts to 135 tons per thousand persons. In other towns the values are as follows:—

Paris	240 tons	Lille	232 tons
Hamburg	182 tons	Nancy	230 tons
London	302 tons	Zurich	227 tons
Other English towns	350 tons		

In New York and Brussels, the collection of household refuse is made at the same time as the road sweepings, and the total amounts are, for New York 536 tons, and for Brussels 490 tons. In London the sweepings alone amount to 250 tons, making a total of 552 tons altogether per thousand persons. In other English towns the weight of road sweepings is 150 tons per thousand persons.

In Brussels the amount of household refuse is 410 tons per thousand persons, so that the sweepings and dust from the streets amount to only about 16·3 of the total. The composition of the Brussels refuse resembles very much that of English and north German towns where coal fires are used.

It is pointed out that refuse destruction by fire is condemned in certain quarters, because it deprives agriculture of the fertilising matters and nitrates contained therein, which are considered to be indispensable to the success of agriculture.

As the result of very careful analyses showing the various quantities of nitrogen, phosphoric acid, potash and lime contained in the refuse, the following values have been arrived at. In Paris the value of refuse from the agricultural point of view is given as 8·9 francs; at Lille, 6·5 francs, and at Brussels 10·2 francs. These prices, however, are not attainable as the cost of transport enters largely into the question. Thus, notwithstanding the advantageous situation of Brussels, due to the canal which permits of very low freights for haulage, the price attainable from the farmers in 1901 was only about 1 franc per ton, or a tenth of the estimated value, and even at this price less than 42 per cent. of the total was sold, no customers being found for the surplus, which had to be transported and tipped into heaps at a cost of 1·3 francs per ton.

The increasing use of chemical manures, too, is correspondingly reducing the system of manuring by refuse, so that destruction by fire is now found to be the only satisfactory method of dealing with it.

An interesting historical sketch of the refuse disposal problem and cleansing of the streets is given, for details of which our readers are referred to the original paper or to the translation, which may be had from the Horsfall Destructor Co.

A deputation visited Hamburg, Berlin, and England, including the towns of London, Leeds, Bradford and Huddersfield, in order to make a thorough investigation into the various methods of refuse disposal. This tour resulted in the "Horsfall" system being adopted. The Hamburg plant, which is also on the Horsfall system, served as a type, and the general arrangements there have been largely followed.

The destructor consists of two blocks of back-to-back cells, each block comprising 18 cells. In each block the flues for the air circulation are adjacent to the hot flue, which is placed in the centre of the arrangement and serves for the whole of the cells. The clinkering and ashpit doors are in front, and charging is done from a platform above the furnace, the refuse being transported by overhead cranes and tipped close to the charging holes.

The engines and dynamos installed in the engine room supply power to drive the fans for the furnace, the overhead crane, the crushing machinery and the electric lighting of the whole system.

The clinkers are drawn out of the cells into wagons, which are run on rails in front of the clinkering doors. They are then conducted along these rails to the crushing plant, and are quenched under a rain of water from a ventilating tower before being delivered into the jaws of the crusher. Leaving the crusher, the clinker is delivered by an elevator to a revolving screen, which then delivers it in three different sizes into separate hoppers. The dust from the crushing plant is collected, soaked, and by means of a suction fan delivered to the centre of a dust slacking tower.

The whole of the auxiliary machinery is driven by electric motors.

A NEW BATTERY SWITCH.

A serious objection to the ordinary charge and discharge switches is the large number of heavy copper connections between the battery and the switch which they necessitate, and many attempts have been made to reduce this number of connections. One way of doing this consists in connecting several cells, instead of only one cell, between each pair of switch contacts, and then reducing the voltage variations to 2 volts by means of auxiliary cells. This method, however, involves difficulties in charging the auxiliary cells, as these must either be charged separately, from some independent source, or else the whole battery must be quite disconnected from the bus bars during the charging period. A better method consists in using a few of the cells from the other end of the battery in place of independent auxiliary cells, and in a paper recently read by Herr C. Liebenow before the Elektrotechnischer Verein (*E.T.Z.*, May 4th, 1905), the theory of this method is considered in some detail.

An installation of this type has been at work for some time at the Paris terminus of the Northern of France Railway. In this case two cells are connected between every pair of contacts on the main cell switch, whilst a single cell at the other end of the battery is connected to a second switch, and every time the main switch is moved this auxiliary cell is either inserted or withdrawn automatically. The method of interconnecting the switches for this purpose is described in the *Elektrotechnische Zeitschrift* for 1903, p. 809.

Fig. 1 shows diagrammatically the connections of a battery installation arranged on this principle. At the right-hand end of the battery, every fourth cell, for instance, is connected to the main cell switch Z, whilst at the left-hand end three consecutive cells are connected to the auxiliary cell switch H by means of four conductors. The mechanical inter-connection of the two switches is not shown. In order to vary the circuit voltage between J_1 and J_2 by steps of 2 volts only, the auxiliary switch alone would be moved at first, so as to cut out a single cell at a time, the main cell switch remaining fixed. After all the three auxiliary cells had been cut out the next step would consist in moving the main switch over one contact, and, at the same time, moving the auxiliary switch back on to the last cell of the battery. These two movements should take place as nearly as possible simultaneously, in order to avoid fluctuations in the lights. In this cycle of operations it will be seen that the auxiliary switch first makes three steps of 2 volts each, and then one of 6 volts, so that if the short-circuiting of the cells were prevented by means of the ordinary resistance inserted between the front and back parts of the contact arm, this resistance would be very unequally loaded at the different steps. This

difficulty can be easily overcome, however, by returning to the older type of cell switch, in which the double contact arm is replaced by intermediate resistance contacts introduced between the main contacts (see fig. 1, H).

A simple formula for deciding the best number of cells to be placed between each pair of main switch contacts, in order to reduce the number of connecting leads to a minimum, is given by Herr Liebenow:—

Let N = maximum number of cells to be cut out.
H = number of auxiliary cells.
L = number of connecting leads (including the leads at both ends of the battery).

Then $$L = \frac{N + H^2}{H + 1} + 2$$

is the general formula, applicable both to the case in question and to the ordinary method of cell switch connection (where H = 0, of course). From this expression it is easy to show that, for a given value of N, L will be a minimum when $H = \sqrt{N + 1} - 1$. Thus, in the case of a battery requiring a total of 35 regulating cells (a variation of 70 volts), the number of connecting leads between battery and switch with the ordinary type of cell switch would be 37, whilst with the new arrangement, if H is made equal to $\sqrt{N + 1} - 1 = \sqrt{35 + 1} - 1 = 5$ auxiliary cells, the total number of leads will be $L = \frac{35 + 25}{6} + 2 = 12$, or a saving of about two-thirds of the copper as compared with the ordinary arrangement.

The way in which the number of leads varies with H may be seen from the following tables, giving the number of leads for various values of H for batteries having 57 regulating cells and 20 regulating cells respectively:—

57 regulating cells.		20 regulating cells.	
H	L	H	L
0 (ordinary cell switch)...	59	0 (ordinary cell switch)...	22
1	31	1	13
2	23	2	10
3	19	3	10
4	17	4	10
5	16	5	10
6	16	6	10
7	16	7	11
8	16		
9	16		
10	17		

It will be seen that the change from no auxiliary cells to one auxiliary cell produces the most marked saving in leads, and after that the saving effected by each additional auxiliary cell gets less and less, until a minimum (not very well defined) is reached. The maximum saving, as compared with the ordinary arrangement, is greater, the greater the number of regulating cells.

Whether it is advisable in any particular case to employ the number of auxiliary cells giving the maximum saving in leads depends on the constructional details of the switches and on the

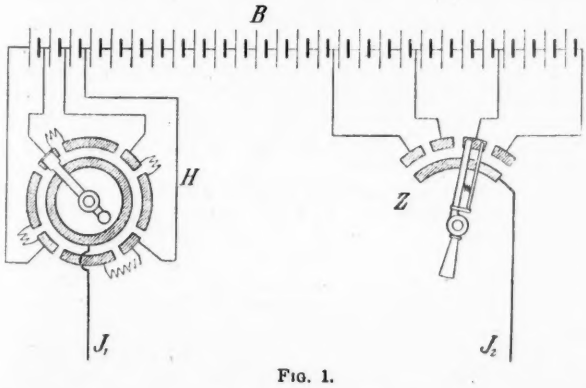


FIG. 1.

actual size of the conductors required, because, of course, it is the minimum combined cost of switches and leads, and not simply of leads alone, which is desired. In the case of cell-switches of the ordinary type, with a large number of contacts, it is probable that the new type of double switch would come out the cheaper because of the reduction effected in the number of contacts.

In the discussion which followed the reading of the paper, attention was drawn to the fact that, in the ordinary charge and discharge switch, provision is made against the charge switch passing the discharge switch, and the possibility of passing a charging current in the reverse direction through certain cells is thus avoided. With the new type of switch this provision cannot be made, as the auxiliary cells must be arranged for switching in or out on the charge and discharge side quite independently. Herr Liebenow, however, considered that, with intelligent attention, such as the switches would receive in central stations, it would only be for short periods, and at comparatively low currents, that this reversed charging would take place, and under these circumstances modern cells would not suffer at all, especially if the particular cells which had been over-discharged received an occasional independent charge.

OVERHEAD ACCIDENTS AND THEIR PREVENTION.

(*Concluded from page 752.*)

HITHERTO there has been too much of the inspection between repairs business. In future the motto ought to be repairs between inspections.

The definition of an inspection varies with every system. Usually its scope is defined by the lineman, who is accepted as knowing more about his work than anyone on the job. The limits of variation are wide, and extend from the minimum, which consists in the lineman resting the horse outside the door of an inn during one portion of the day and resting himself on the top of the tower wagon during the remainder; to the maximum, which comprises a minute examination of every ear, of every hanger, every other insulator, every span-wire termination, the trolley wire under each ear and the whole length between, the condition of all guard wires, the state of the section feeders and of the controlling section boxes, and of many details too numerous to specify in a general article. Real inspection includes not only all these things, but it attaches great importance to the electrical testing of all insulators, so that if one of them wants to fail it is given an opportunity to do so with the least trouble to itself and everyone else, and if it has not waited for the test, but was prevented by a second insulator from earthing the line, it will betray itself directly the test is made and will be removed without delay.

Every lineman should send in a detailed report of work done at the end of every day or night, together with a statement of any repairs which he considers necessary, or which he was obliged to leave undone; and an assistant should be charged with the duty of collating these reports, and of presenting their contents, in a condensed and regular form, at regular intervals to the general manager. These reports, when filed, will form a most valuable history of the overhead construction, and might be conceivably of considerable use in demonstrating to an inquiring official of the B. of T. or to a coroner, or even to a wrathful committee, that every possible precaution has been taken to prevent some lamentable accident.

The purely trivial mishaps will not occur on a line which is protected in the manner sketched, so that an accident when it does come is likely to be a big one. It is unnecessary to point out that the badly protected line will not escape the big accidents, and it will never be free of the little ones.

Rumours and ascertained facts from many parts of this country have made it evident that the foregoing remarks are not idle words, and it is most significant of the view taken by those who have detailed information from all sources that the B. of T. in recent Light Railway Orders has inserted a new clause which stipulates a fortnightly test of every insulator. It may be taken for granted that this clause will be extended to have a general application in the course of time, so it will be as well for everyone to start at once to do willingly what they will have to do willy-nilly before long.

Personally, we think that the B. of T. has carried its provision for safety a little too far, and has made it irksome beyond need, as it is so prone to do. We allow that under certain unfavourable conditions of a purely local nature an inspection and test of every insulator may be made every fortnight with advantage; and we go so far as to say that where the damage and injury caused by a defect in the overhead equipment, whether at an insulator or at any other part, is likely to be particularly serious, by reason of the congestion of traffic and people, that space might be better protected by an even more frequent inspection; but we are just as much of the opinion that any portion of a line, constructed in such a manner as to satisfy the B. of T., which passes through a district in which the probability of injury ensuing from the fall of a wire, or the "enlivenment" of a pole, is remote, may be let off with an unfailing monthly inspection. It follows from this that a line which is partly urban and partly suburban, would be inspected more frequently on the former than on the latter section, and it would be open to the inspecting officer of the B. of T. to mark off every portion

of a line with relation to the frequency of inspection and testing required just as he now marks off a line with relation to maximum speeds.

When a line is in good trim, no matter how old it may be, one lineman—assumed to be a competent one—can cover 15 to 20 miles of route; that is to say, he can inspect and do all the necessary repairs on that length. The amount of night work which he has to do will depend partly on the frequency of service on any part of the line during the day, and partly on the nature of the repair. When inspecting only, he can get along well enough with the occasional assistance of the horse-driver; when on repairs he will require a skilled mate.

So much for the accidents caused by wear and tear and exposure. It is evident that inspection is the key-word of that section.

There is nothing left but accidents which may be attributed to some external agency, and these may be summed up under the heads of Acts of God, and contributory negligence on the part of persons other than those directly responsible for the overhead equipment.

Against the first no man may fend. A heavy direct lightning discharge, an overthrown tree, a cyclone, or a fire, are some of the parents of disaster against which neither specifications, manufacture, construction nor maintenance can avail, although the omission of lightning arresters and sensitive cut-outs cannot be recommended on those grounds.

Against the second continual war is being waged, sometimes embittered by the division of the traffic and the engineering departments. Chief among the causes is the damage done by the immortal "fiendish, flying trolley," brought about in the ways well known to motormen and conductors. Trolley retrievers, B. of T. regulations, have not sufficed to cure these evils, and nothing but the bow trolley, which is possible in many cases and impracticable in others, will bring about that end.

Accidents caused by fallen message wires are viewed from different standpoints by the owners of the tramways and the owners of the wires. The former class them with those caused by contributory negligence, while the latter describe them as due to *force majeure*, and escape condemnation. As a rule the law decides.

Let it be known, therefore, to all concerned—and who, out of all who use the streets, is not?—that the majority of accidents arising from the overhead equipment of electric tramways are avoidable: and let it be known, also, to those more intimately concerned, that preventable accidents are cheapest prevented.

LAMBTON COLLIERIES POWER DISTRIBUTION SCHEME.

We have recently had an opportunity of looking through the specification in connection with the above important scheme, and as we think that it will be of general interest to our readers we give a summary of the requirements and general conditions. The specification occupies some 25 pages of printed foolscap, and we much regret that we are not able to give the name of the author, as this does not appear anywhere on the document.

We infer from the first clause that a generating plant is also to be put down or already exists, as the work commences from the switchboard in the generating station, and includes all the necessary material for a complete working scheme.

Regulations.—It is specified that the whole of the work is to comply with the rules issued by the Home Office, regulating the use of electricity in mines, although in a subsequent portion of the specification, there is a clause reading as follows:—

"The German or I.E.E. wiring rules shall be enforced for all matters not specially alluded to in the specification." It is the first time we have seen the German rules quoted in an English specification, and this may serve as a clue to the nationality of the author, as also do the spelling and composition.

System of Distribution.—The work is on the three-phase alternating system; this we gather from the context, as it is nowhere specifically stated. The voltage of the high pressure distribution is 6,000, the low pressure 500, the frequency being 50.

Tests.—"12,000 volts alternating will be applied at the stator between winding and carcass for half an hour." This test is to be taken at least seven days after the winding has been baked for the last time. In the case of pump motors this test is to be applied after the motors have been standing for 14 days in a saturated atmosphere at 70° F., but the pressure in this case will be 12,000 volts for the 6,000-volt motors, and 2,000 volts for the 500-volt motors. We gather that the 12,000 volts is to be applied to the whole of the motors in the first test referred to.

The insulators are to be tested with a pressure of 12,000 volts *immediately* before erection, and the contractor is "to provide the necessary machinery and instruments to this effect."

Temperature Rise.—The temperature rise varies from 65° to 75° F. in different cases, and the specification reads "the temperature of the winding being measured at (? as) a function of the increase in resistance and not with the thermometer." The resistance of the stator winding only is, no doubt, referred to, as the temperature rise of the rotor could hardly be measured in this way. The insulation of the rotor is to be tested with two and a half times the maximum voltage for half an hour with a maximum of 2,000 volts in any case.

Overload Capacity.—This clause reads somewhat peculiarly, as follows:—"All motors must be capable of withstanding 100 per cent. overload once running at full speed with corresponding temperature rise. They are to be capable of maintaining their full torque with but 70 per cent. of the normal voltage at the terminals." "Once running" probably means "when running;" as no time limit is given, it follows that the motors must stand 100 per cent. overload for the full period of test, say six hours, with "corresponding temperature rise." What is meant by this last expression? The heating effect is, of course, proportional to the square of current in the windings, and not directly, as might be supposed from the wording.

Efficiency.—The efficiency of each motor is to be stated in the tender, and 10 per cent. of the price of the motor will be deducted for every 1 per cent. drop below the guarantee, and the motors are liable to be rejected if the efficiency is 3 per cent. below the guarantee.

If the company's engineer thinks fit, he shall carry out special tests with a view of ascertaining if the motors come up to the specified requirements as regards overloading, &c. But the specification does not say at whose expense these tests will be carried out.

Details to be Supplied.—A detailed specification, as well as complete drawings for every motor and controller are to be sent in with the tenders, and the contractor is to send in a sketch showing how he proposes to bring his high-tension wires through outside walls.

Penalty.—If the controllers do not give satisfaction during the first month of operation, or "if through their agency any engine is laid idle more than five hours in all," the contractors shall be notified in writing by the company, who shall then be at liberty to order controllers of any other make.

Further, should a motor or controller be so defective that it is impossible to work the haulage with them, an indemnity of £20 for every 10 hours' total stoppage shall be deducted from the amount payable to the contractor.

Switches and Fuses.—All H.T. switches used underground are to be of the oil-break type. The low-tension switchgear is to be solid and safe to handle.

"The types of all switches shall be approved of beforehand, the company having the right to impose any model it chooses. Samples and complete drawings are to be forwarded with the tender." It would surely have saved a lot of trouble had the maker's name been specified, as, clearly, some special design will be "imposed."

Cables.—All mine cables are to be double armoured and three-cored, preferably lead-covered with paper insulation,

and are to comply with the proposed new rules for electricity in mines.

The cables for lighting circuits are to be rubber-insulated and run on porcelain insulators.

"The insulation shall withstand after 20 hours' immersion in an acidulated bath, 2,000 volts alternating between copper and water for half-an-hour, the insulation being 600 megohms per mile, at 60° F."

Between the H.T. three-pole switches and transformers, motors, &c., V.R. covered cables, non-armoured, are to be used; the insulation is to withstand 12,000 volts for half an hour, and to be of 3,000 megs. per mile up to ·05 sq. in. section and 1,500 megs. for larger sizes.

Overhead Lines.—These are to consist of phosphor-bronze wire "having 98 per cent. of the conductivity of chemically pure copper as defined by Mathiessen's standard." It is well known that Mathiessen's standard does not represent chemically pure copper, as the author of this document appears to suppose, and it is quite usual nowadays to specify for copper having 100 per cent. conductivity, as defined by this standard. The wire used is to be of uniform size, namely, 0·35 in. in diameter.

The joints in the overhead conductor are to be scarfed and brazed with silver solder; they are then to have the same mechanical and electrical properties as any other part of the wire, *i.e.*, they must have a breaking strain of not less than 30 tons tensile per sq. in., and must not break when wound on a mandrel of 1 in. diameter. It is not clear if any joints made on site are to be subjected to these tests.

Lighting.—A price per lamp is to be given for any additions required above the specified total number. This is impracticable, as a light may be tapped direct on to a pair of leads, or may be 50 yards or more away from the nearest wires.

Herrington Colliery.—The lighting transformer is "to satisfy the general *prescriptions* relating to this type of machinery."

"The voltage drop on the secondary between no load and full, and *vice versâ*, shall not exceed 1½ per cent." (Our italics.)

Compressor.—To be of the two-stage type with cylinders in tandem. Output 800 cb. ft. of free air per minute, pressure 70 lb., speed not to exceed 100 r.p.m. "No special type is specified," but "Ehrhardt & Sehmer, Riedler, Ingersoll, &c., make, will receive consideration." Presumably the author of the specification has never heard of an English make of compressor, and judging from his English composition, we should not be surprised to learn that he is not very well acquainted with English practice at all.

The belt pulley "is to be of such a *momentum of inertia* (our italics), that a regularity of $\frac{1}{100}$th at the most, is obtained per revolution." The author probably has the fly-wheel in mind, but what is "momentum of inertia?"

Compressor Motor.—This also is required to have somewhat special characteristics. It is to be of the asynchronous three-phase type, 135 H.P. at 500 volts; no load speed 500 r.p.m. This is plain enough. But although the speed is here given as 500 r.p.m., we read later that the speed "will have to be determined in conjunction with the maker of the compressor"—and whilst the pressure is given as 500 volts in one place, we learn, a few paragraphs lower down, that "it is proposed to drive the motor direct off the high tension mains." It is, moreover, to be of "the Arnold two-speed type . . . dust and gas proof . . . and fitted, if possible, with an automatic starting arrangement, enabling it to start with the normal torque, thus doing away with a starting resistance proper. Due consideration must be taken of the inertia of the fly-wheel and the time taken to accelerate the same with the given torque." But the time allowed for acceleration is not given.

Haulage.—To consist of four 5-ft. drums, each fitted with a clutch and two brake rings. To be geared by a double set of gearing, each having a ratio of four to one, to a motor running at 480 r.p.m. The motor pinion to be of gun-metal "with straight teeth," and the wheel of steel "with machine cut teeth." The difference between straight and machine-cut teeth needs a little explanation. For the slow-speed motor, steel gear with angular teeth will be used. "Slow speed motor" is probably an error for "slow speed motion."

For gearing subjected to such sudden strains, good quality cast-iron is safer than steel. An undiscovered blow-hole at the root of a tooth may at any time cause a smash up.

The motor is to be of the slip-ring type, and to run on the 500-volt circuit. It is to work under its best conditions as regards efficiency and power factor when developing 180 B.H.P. It is to give this output continuously for six hours with a maximum temperature rise of 65° F. when working in an atmosphere at 70° F., "and the ventilation indifferent." So far so good, although the expression "ventilation indifferent" is superfluous if the atmospheric temperature does not exceed 70° F.

But there are some rather extraordinary conditions to be complied with, and the author appears to have but the vaguest notion of the meaning of the word "torque." Thus—"the motor is to be capable of starting the load on the steepest gradient with tubs off the rails."

"The effort in this case must be equal to 400 B.H.P. In ordinary times, the motor, in conjunction with the controller, must be capable of starting with 350 B.H.P. torque every five minutes. Time taken, 10 seconds." The controller is to be capable also "of regulating the speed from 3 to 1 for 3 minutes, the motor developing 200 B.H.P. This occurring every 10 minutes." In one place we read "speed of rope 9 ft. per second on an average." That this is not the case is sufficiently obvious from the following illuminating paragraph. The italics are ours:—"The rope speed *at full speed* being 9 ft. per second, the amount of resistance *susceptible* of being put into circuit must be sufficient to reduce this speed to 3 ft. per second, the motor developing a torque corresponding to 80 B.H.P. at 480 r.p.m. At the lower speed (if a two-speed motor be used) this torque corresponds to 40 B H.P. This occurring every 10 minutes alternately with the regulation with the 200 B.H.P. output, the interval being therefore 5 minutes between the two. Time in circuit 3 minutes." Before drawing up another specification the author should first learn how to express himself correctly, or, at any rate, intelligibly, in English, and should then learn the meaning of the word torque.

First we are told that the average rope speed is 9 ft. per second; then that it varies from 3 to 9 ft. We are informed also that the motor will develop 200 B.H P. whether the rope is running at 3 or at 9 ft. per second when drawing the same load—an obvious fallacy; and later we are told that at full speed the motor will develop "a torque corresponding to 80 B H.P." If it is a two-speed motor it will develop half this torque at "the lower speed."

It is really impossible to conjecture what the author is driving at, and we should like to ask whether he really knows what he is talking about. May we take the liberty of informing him that torque is expressed in foot-pounds, and the torque exerted by a motor is the pull in pounds at the periphery of its armature, rotor, or pulley, multiplied by the radius of the same in feet. The expression 350-H.P. torque is therefore absolutely meaningless, as are also 400-H.P. torque, 80-H.P. torque, 40-H.P. torque, and the like. Torque cannot be expressed in horse-power, as we can have torque without motion, whereas the term horse-power, being a rate of doing work, cannot be correctly applied to a stationary machine. We thought that every engineer knew this, but the author says the motor must be capable of exerting 400 B.H.P. to start the load from rest, that is to say, at zero speed. What he ought to have given was the torque in foot-pounds or merely the pull on the rope in pounds.

To refer to another point, or rather to one of the same points from a different aspect: "The motor . . . must be capable of starting with 350 B.H.P. torque every five minutes. Time taken 10 seconds." We do not know the size of the generating plant proposed, but, as lighting and power are supplied from the same plant, it does not strike us as a sensible proposal to throw a 350-H.P. motor on and off every five minutes.

Experience with three-phase haulage is not favourable to this practice, and it has been abandoned in favour of the use of clutches for throwing the load off and on.

(To be continued.)

COMFORT OF EMPLOYÉS IN ELECTRICITY SUPPLY.

THERE are more things in engineering practice than can be expressed by mathematical formulæ, and one of these is the influence of the physical comfort of the operatives of an electricity supply system on the cost of production. A man may go to work with either of two intentions—to get a little money wherewith to buy a pleasureable life elsewhere, or to get his pleasure out of his work. It is a callous cynicism born of shallow observation to say that the bulk of operatives, fairly treated, belong to the first class; unless the conditions are made too stultifying, an employé will, in self-defence, take an interest in his job as the best means of filling in his time while at work. It is a perfectly legitimate point of view to regard the men on a plant as so much mechanism. Economic considerations forbid excessive humanitarianism. But a grave mistake is made by many employers in subordinating the finer mechanism to one less wonderfully constructed. The steam engine is, according to these quidnuncs, to be humoured in every detail; the man-engine never.

In a recent issue of our American contemporary, the *Electrical World and Engineer*, appears an article by Mr. Paul Lüpke, which deals with this phase of electricity supply in such a trenchant manner that we make no apology for extracting some of the "wise saws and modern instances" given in epigrammatic form therein.

Speaking of the boiler-house staff, Mr. Lüpke says:—

It must be borne in mind that there is no other individual employé of the company who has greater opportunity to misuse the trust imposed upon him, and who can so readily cover up his tracks as the fireman. All the more surprising it must be, then, to find him so often working in a wretched hole, deprived of proper light, exposed to cold draughts, trampling on a heap of coal wheeled in for the night's run, smothered with dust from red-hot ashes pulled out on the floor, practically imprisoned for the better part of his working hours; in fact, surrounded everywhere with every conceivable discomfort. And still we expect satisfactory results. Can conditions such as these do anything but be productive of a chronic "don't care a ——" disposition, a disposition that will induce the fireman to shovel in the coal to get it away from under his feet, to make himself elbow room for handling his tools, to heave in lumps of size limited only by his own lifting capacity or the area of the firedoor opening.

This is not sentimental compassion for the poor misused fireman, but cold business calculation. A man in discomfort is no angel. He will lay himself out for deeds of darkness, ranging from seditious talk to assassination. Russia has been held up as an object lesson for many schools of thought of late, and it may well serve our present turn. The policy of flogging a horse is only sound when the distance to be covered is very short. As the article from which we quote, says:—

Create conditions under which it is impossible to wear more than half an undershirt and little more of a pair of overalls, and you will always have firemen who cannot afford to wear much else. Said a superintendent after a serious accident in the fire-room, due to the presence of an explosive mixture of carelessness and stupidity. 'Now, what can you do with that kind of cattle?" Cattle, indeed! If your fire-room is a cattle pen, cattle is all you will ever get to stay in it. For a clerk in the office who can merely juggle the figures unalterably produced by the operating force, every reasonable comfort is liberally provided; he is not asked to sweep the floor or to clean the spittoons. But the man in the fire-room to whom we entrust material representing large sums of money, charging him with its proper use, we compel to work in dire discomfort, and for no other good reason than that it seems to be a settled old tradition that a fire room must be the dirtiest and most dismal part of a station.

Obviously, then, the value of ash and coal elevators, crushers, and such apparatus, is not merely to be judged by the shillings per week saved in labour, but also by the better fitness and willingness of the operatives retained on the plant.

Turning to the engine room, Mr. Lüpke says:—

Freedom from physical discomforts for the attendants might be considered in the nature of insurance against accidents and undue wear. Let the designer do his best to locate on one level all parts of machinery that need the frequent attention of one man. Let him figure out how many foot-pounds it takes to climb a 12-ft. stairway every 10 minutes on a shift. It pays to spend money, to save the energy and patience of attendants for useful tasks. Stair-climbing is not one of these.

Neither, we may add, is the dislocation of one's neck in attempting to read meters and gauges at a high level. The following remarks, in conclusion, convince us that the writer has been through the mill, and knows what he is talking about.

Try to avoid a plan that includes dark and almost inaccessible corners, and do not stow condensers, pumps, pipes and cables away in them out of sight and out of reach. If you are inquisitive, how often now will you encounter neat iron steps equipped with highly polished brass railings leading down into a dark slimy condenser pit? Do not install valves, pipe flanges, &c., in places where it practically requires a fire and waterproof contortionist to effect necessary repairs. Did you ever see a mere flesh-and-blood man throw down a wrench or a hammer in utter despair and hear him cry out in unprintable language, "Now, if I had the man here who put that valve there, wouldn't I do things to him?" Exposed polished nuts on hot parts of a steam engine, where the heat will constantly tarnish them, are an unmitigated nuisance. Rough surfaces that cannot be wiped off without catching fuzz and lint, avoidable angles and inaccessibly sharp corners, are all things that not only unnecessarily try the tempers of everybody about the plant from the wiper to the superintendent, but represent a very tangible increase in the operating expense.

There is no need to further elaborate the argument. Work, if it is straightforward and solid, can be portioned out to the staff so as to utilise each man to his best labouring capacity. When, however, it is made artificially difficult, by carelessness in design or management, a cumulative process of inefficiency and sloth is begun which puts an end to proper economy.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

5,821A. "Telephonograph." J. SKWIRSKY. (Date applied for under Patents Rule 9, March 20th, 1905.) April 26th.

8,697. "Electric belt." T. BERNDT. April 25th. (Complete.)

8,701. "Improvements in means for supporting telephone receivers." F. W. ST. JOHN. April 25th. (Complete.)

8,711. "Improvements in relating to the distribution of electric energy to apparatus capable of being operated by direct and also by alternating currents." B. G. LAMME. (Date applied for under Patents Act, 1901, May 3rd, 1904, being date of application in United States.) April 25th. (Complete.)

8,721. "Improvements in processes of preparing nitrogen-oxygen compounds by means of electricity." WESTDEUTSCHE THOMASPHOSPHAT-WERKE G.m.b.H. (Date applied for under Patents Act, 1901, April 7th, 1905, being date of application in Germany.) April 25th. (Complete.)

8,728. "An improved trolley retractor." H. M. LOVE. April 25th. (Complete.)

8,732. "Improvements in systems and means for laying electrical wires in conduits." G. M. GEST. April 25th. (Complete.)

8,789. "Method for safeguarding electric unipolar cells." M. GRISSON. April 26th. (Complete.)

8,821. "Improvements in the regulation of electric circuits, subject to rapidly-fluctuating loads." E. S. G. REES, C. H. ILES and W. ARMISTEAD. April 26th.

8,828. "Improvements in electric arc lamps." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) April 26th.

8,829. "Improvements in electric arc lamps." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) April 26th.

8,838. "Improvements in and relating to apparatus for telegraphic purposes." J. T. SZEK. April 26th.

8,843. "Improvements in lifeguards for electrically-driven tramcars, trains and other vehicles supplied on the overhead or trolley system." W. T. SKELDING & Co., LTD., and F. C. GEARY. April 27th.

8,846. "An improved electrical collector trolley head." R. BARON. April 27th.

8,847. "Improvements in apparatus for controlling poles and ropes of electric tramway vehicles." W. J. BOWDEN and J. W. CRONKSHAW. April 27th.

8,890. "Improvements in wireless telegraph system." H. SHOEMAKER. April 27th. (Complete.)

8,891. "Improvements in and relating to filaments for electric and other lamps." E. L. FRENOT. (Date applied for under Patents Act, 1901, May 7th, 1904, being date of application in Belgium.) April 27th. (Complete.)

9,806. "Improvements relating to the distribution of electrical energy." E. R. HILL. April 27th.

8,907. "Improvements in systems of electrical distribution." P. M. LINCOLN. (Date applied for under Patents Act, 1901, May 3rd, 1904, being date of application in United States.) April 27th. (Complete.)

8,913. "An improved controlling system for electric railways." T. VON ZWEIGBERGK. April 27th. (Complete.)

8,919. "Improvements in connection with igniting devices for internal combustion engines." MARQUIS A. DE DION and G. BOUTON. (Date applied for under Patents Act, 1901, February 10th, 1905, being date of application in France.) April 27th. (Complete.)

8,921. "Improvements in electric railway systems." G. L. CAMPBELL and W. M. STEPHENS. April 27th. (Complete.)

8,931. "Improvements relating to points or switches for electric tramways working upon the slot conduit system." A. N. CONNET. April 27th. (Complete.)

8,938. "An improvement in adjustable brackets for electric lamps." A. J. WHITCOMBE and M. WILLIAMS. April 28th.

8,972. "Improvements in systems of electrical distribution of direct currents by means of vapour rectifiers." P. C. HEWITT. (Date applied for under Patents Act, 1901, May 13th, 1904, being date of application in United States.) April 28th. (Complete.)

8,973. "Improvements in vapour electric apparatus." P. C. HEWITT. (Date applied for under Patents Act, 1901, May 13th, 1904, being date of application in United States.) April 28th. (Complete.)

8,975. "Improvements in automatic telephone exchange systems." B. KUGELMANN. (Date applied for under Patents Act, 1901, April 29th, 1904, being date of application in Germany.) April 28th. (Complete.)

8,991. "An improved process for insulating electric wires and cables." LA COMPAGNIE FRANCAISE DE L'AMAINTE DU CAP. (Date applied for under Patents Act, 1901, May 10th, 1904, being date of application in France.) April 28th. (Complete.)